CAIS STANDARD MANUAL

SYSTEM NO. 23
INFRASTRUCTURE

CAS PROJECT
CAIS MANUAL

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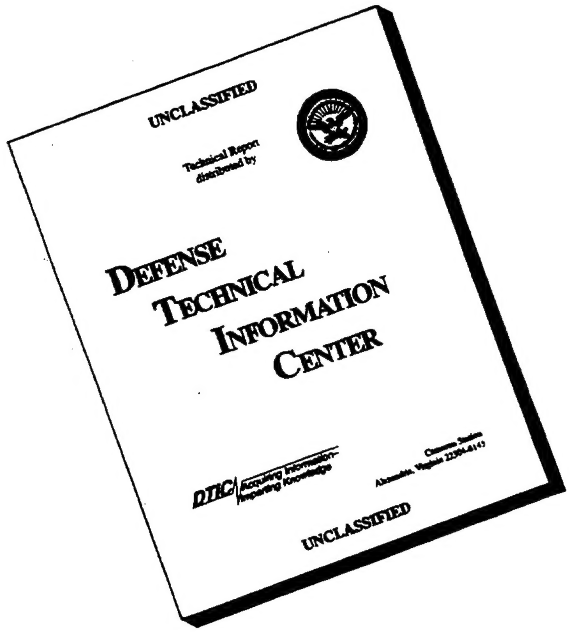

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FROM: AL/EQ (STINFO)
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1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

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3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman

LARRY L. TESTERMAN
Scientific and Technical
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Atchs: Manuals

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23 INFRASTRUCTURE

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   A. Level I Inspection Method Description
   B. Level II Inspection Method Description
   C. Level III Inspection Method Description

II. General Inspection
   A. Process. This section describes the process of the inspection activity.
   B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Infrastructure System.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of infrastructure systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. The survey activity is designed to be performed by a single surveyor.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. There are very few Level II inspections in Infrastructure, since most defects are readily apparent from a Level I. The majority involve the inspection of deterioration, fungi decay or parasite damage to wood components, the inspection of insulation on piping, or the inspection of grinding noises in pumps and motors. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 23-A provides the breakdown from system through component for the Infrastructure System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

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If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Plans, sketches and/or maps are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended numbering schemes for the installation. The installation may have areas physically identified by a numbering system or identified on the plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each area, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Infrastructure System requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Civil" and "Mechanical" disciplines.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Infrastructure System require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The IU's for the most common components would be defined as follows:

- Piping IU - The linear footage of the affected section of pipe containing the defect in a particular location; e.g., from manhole-to-manhole, culvert-to culvert, support column-to-support column, building-to-building, etc.
- Valve IU, Sump IU, etc. - Singularly defined items such as these are defined as each.

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V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary
- Wet suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers
Pocket knife or ice pick
Scraper
Wire brush
Hydrant wrench
Hammer (for sounding)
Calipers
Measuring scales

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

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IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

The following is a list of the Level III Inspection Methods that are not flagged at the observation level in the DOD CAS Manual, but are available to the Facility Manager:

1. Checking the windings of electric motors for open circuits, grounds or deteriorated insulation.
2. Investigation of leaks in underground piping.
3. Ultrasonic thickness testing of piping, fittings and valves.
4. Flow rate efficiency check of distribution system.
5. Check of the impressed current cathodic protection system.
6. Sampling of water to determine quality degradation and contamination.

There exists break points where it is more cost effective to replace equipment or components rather than expend the cost to perform a Level III inspection. It is recommended that the Facility Manager review the base replacement records for equipment and components. A sizing guide can be developed to establish the most cost effective approach of either initiating a Level III inspection or replacement of equipment or components.

It is recommended that the sizes of equipment listed below be the criteria for the lower limit for which a Level III inspection is considered.

Pumps	40 GPM
Motors	60 HP

The Facility Manager is not limited by these sizing guides, he can authorize any Level III inspection he feels necessary for specialized equipment or components.

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XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Infrastructure.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Infrastructure.

Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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Figure 23-A. WORK BREAKDOWN STRUCTURE

SYSTEM / **SUB-SYSTEM** / **COMPONENT**

- 23 INFRASTRUCTURE
  - 23.01 Potable Water Distribution System
    - 23.01.01 Pump Base and Coupling
    - 23.01.02 Pumps
    - 23.01.03 Motors
    - 23.01.04 Controls
    - 23.01.05 Piping and Fittings
    - 23.01.06 Valves
    - 23.01.07 Metering Devices
    - 23.01.08 Hydrants
    - 23.01.09 Manholes
    - 23.01.10 Engines
    - 23.01.11 Valvebox - Concrete
    - 23.01.12 Valvebox - Brick, CMU or Stone
    - 23.01.13 Valvebox - Steel
  - 23.02 Non-Potable Water Distribution Systems
    - 23.02.01 Pump Base and Coupling
    - 23.02.02 Pumps
    - 23.02.03 Motors
    - 23.02.04 Controls
    - 23.02.05 Piping and Fittings
    - 23.02.06 Valves
    - 23.02.07 Filters
    - 23.02.08 Hydrants
    - 23.02.09 Manholes
    - 23.02.10 Valvebox - Concrete
    - 23.02.11 Valvebox - Brick, CMU or Stone
    - 23.02.12 Valvebox - Steel
  - 23.03 Storm Water Collection System
    - 23.03.01 Arroyos, Ditches and Swales
    - 23.03.02 Headwalls, Aprons and Flared Sections
    - 23.03.03 Piping
    - 23.03.04 Manholes
    - 23.03.05 Inlets and Catch Basins
    - 23.03.06 Pump Base and Coupling
    - 23.03.07 Pumps
    - 23.03.08 Motors
    - 23.03.09 Controls

23 INFRASTRUCTURE

Figure 23-A. WORK BREAKDOWN STRUCTURE (Continued)

SYSTEM	SUB-SYSTEM	COMPONENT
23 INFRASTRUCTURE (Continued)	23.04 Sanitary Sewer Collection System	23.04.01 Pump Base and Coupling
		23.04.02 Pumps
		23.04.03 Motors
		23.04.04 Sewage Ejectors
		23.04.05 Controls
		23.04.06 Piping and Fittings
		23.04.07 Manholes and Cleanouts
	23.05 Chilled Water Distribution System	23.05.01 Pump Base and Coupling
		23.05.02 Pumps
		23.05.03 Motors
		23.05.04 Controls
		23.05.05 Piping, Fittings and Valves - Above Ground
		23.05.06 Piping, Fittings and Valves - Underground
		23.05.07 Manholes
		23.05.08 Valvebox - Concrete
		23.05.09 Valvebox - Brick, CMU or Stone
		23.05.10 Valvebox - Steel
	23.06 Elevated Water Storage Tanks	23.06.01 Concrete Foundations
		23.06.02 Structural Steel Supports
		23.06.03 Steel Ladders/Platforms
		23.06.04 Steel Riser Pipe
		23.06.05 Steel Tank Shell Plates
		23.06.06 Overflow Piping/Vents
		23.06.07 Concrete Tanks an Pedestals
		23.06.08 Altitude Valves
		23.06.09 Cathodic Protection
	23.07 Steam Distribution Systems	23.07.01 Piping, Fittings, Valves and Steam Traps - Above Ground
		23.07.02 Piping, Fittings, Valves and Steam Traps - Underground
		23.07.03 Manholes
	23.08 Steam Condensate Return Systems	23.08.01 Piping, Fittings, and Valves - Above Ground
		23.08.02 Piping, Fittings, and Valves - Underground
		23.08.03 Manholes

23 INFRASTRUCTURE

Figure 23-A. WORK BREAKDOWN STRUCTURE (Continued)

SYSTEM	SUB-SYSTEM	COMPONENT
23 INFRASTRUCTURE (Continued)	23.09 Heating Hot Water Distribution Systems	23.09.01 Pump Bases and Couplings
		23.09.02 Pumps
		23.09.03 Motors
		23.09.04 Controls
		23.09.05 Piping, Fittings and Valves - Above Ground
		23.09.06 Piping, Fittings and Valves - Underground
		23.09.07 Manholes
		23.09.08 Valvebox - Concrete
		23.09.09 Valvebox - Brick, CMU or Stone
		23.09.10 Valvebox - Steel

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

DESCRIPTION

The Potable Water System is a subsystem of the Infrastructure System. The potable water distribution system is the network of pumps, piping and auxiliary equipment required to carry potable water from its source to the using facilities. It serves to distribute and regulate the water supply.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of Potable Water Distribution Systems:

1. Hydrant Wrench
2. Pry Bar

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Potable Water Distribution Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.01.01 PUMP BASE AND COUPLING
- ◆ 23.01.02 PUMPS
- ◆ 23.01.03 MOTORS
- ◆ 23.01.04 CONTROLS
- ◆ 23.01.05 PIPING AND FITTINGS
- ◆ 23.01.06 VALVES
- ◆ 23.01.07 METERING DEVICES
- ◆ 23.01.08 HYDRANTS
- ◆ 23.01.09 MANHOLES
- ◆ 23.01.10 ENGINES
- ◆ 23.01.11 VALVE BOX - CONCRETE
- ◆ 23.01.12 VALVE BOX - BRICK, CMU OR STONE
- ◆ 23.01.13 VALVE BOX - STEEL

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

07.02	DOMESTIC WATER DISTRIBUTION SYSTEMS
30	WATER TREATMENT PLANTS

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Potable Water System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.01.01 PUMP BASE AND COUPLING

The pump base is the mounting platform for the pump and motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective pump or motor mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.01 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			
*** Corrosion (base).**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidence by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidence by holes or loss of base metal.	EA		
*** {Severity H}			
*** Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned, requiring proper disposal.	EA		
*** {Severity L}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.02 PUMPS

Pumps provide for water circulation throughout the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
* **Leakage.**			
Observation:			
a. Leaking at pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
* **Excessive noise and vibration at pump.**			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
* **Defective insulation (where applicable).**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity M}			
* **Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.03 MOTORS

Usually AC motors are used to drive the circulating pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.04 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel enclosures.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.05 PIPING AND FITTINGS

Piping and fittings provide the distribution network for the potable water distribution system. The distribution system is normally located underground, below the frost line. Where piping is exposed, hangers and supports are provided with allowance for expansion and contraction.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water dripping.	EA		
*** {Severity M}			
c. Water streaming.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water dripping.	LF		
*** {Severity H}			
c. Water pressure 50 PSIG or below.	EA		
*** {Severity H}			
*** Defective above ground anchors or supports.**			
Observation:			
a. Improper size or loose.	EA		
*** {Severity L}			
b. Broken or missing.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation/jacket.	LF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.05 PIPING AND FITTINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective galvanic anode cathodic protection systems.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent.	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
*** Corroded anchors or supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.01.05 PIPING AND FITTINGS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log. *** {Severity M}	EA		10
b. Disconnected or missing DC or AC power source. *** {Severity H}	EA		10
c. Zero reading on the meter. *** {Severity H}	EA		10

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.06 VALVES

Valves are normally used to isolate or direct the water flow.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
*** Damaged.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.07 METERING DEVICES

A meter is a device for measuring flow through a pipe or to a facility. They are used for billing purposes but also are essential in controlling excess usage. In-line meters are generally in ground boxes (similar to valve boxes). Meters are either turbine, compound, disc or propeller types.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Inoperable or missing.**			
Observation:			
a. Meter not operating.	EA		
*** {Severity H}			
b. Missing or corroded beyond repair.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.08 HYDRANTS

Hydrants are above ground extensions of the distribution system and are essential to the fire protection network. They are also used for flushing out sections of the system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged.**			
Observation:			
a. Missing hydrant caps, gaskets or chains	EA		
*** {Severity M}			
b. Broken or cracked hydrant.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Seepage, drips, main valve closed.	EA	3	
*** {Severity M}			
b. Steady leak.	EA	3	
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.09 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of masonry units or prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
c. Eroded joints (brick, CMU)	LF		
*** {Severity H}			
d. Loose, broken, displaced brick or CMU.	SF		
*** {Severity H}			
* **Physically damaged.**			
Observation:			
a. Bent/damaged frame/manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing cover.	EA		
*** {Severity H}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H)			
* **Debris in manhole.**			
Observation:			
a. Sand/mud/debris in manhole.	EA		
*** {Severity M}			
b. Surcharged manhole.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.10 ENGINES

Some distribution systems, under special installations, may have diesel or gasoline engine driven pumps. The engines usually have automatic starting systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Faulty diesel or gasoline engines.**			
Observation:			
a. Physical damage to exterior engine parts.	EA		
*** {Severity H}			
b. Leaking fuel or coolant.	EA		12
*** {Severity H}			
c. Broken, loose or missing engine mounting hardware or supports.	EA		
*** {Severity H}			
d. Corroded battery terminals or wires.	EA		
*** {Severity F}			
e. Loose wiring, connections, switches, etc.	EA		
*** {Severity F}			
f. Broken or loose fan belts.	EA		
*** {Severity F}			
g. Engine controller selector switch not in AUTO position.	EA		
*** {Severity F}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.11 VALVE BOX - CONCRETE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or spalling of concrete walls.**			
Observation:			
a. Wide cracks, between 1/16" and 1/4" wide.	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.01.11 VALVE BOX - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2′ of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.12 VALVE BOX - BRICK, CMU OR STONE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged brick, CMU or stone walls.**			
Observation:			
a. Cracked, split or damaged.	SF		
*** {Severity M}			
b. Loose or missing brick or stone.	SF		
*** {Severity H}			
*** Deteriorated mortar joint material.**			
Observation:			
a. Loose mortar joint material.	SF		
*** {Severity M}			
b. Missing mortar joint material.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.12 VALVE BOX - BRICK, CMU OR STONE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharge valvebox.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.01.13 VALVE BOX - STEEL

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Corrosion of steel box.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			
*** Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharge valvebox.	EA		
*** {Severity H}			

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

REFERENCES

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. 2 Inspection of Shore Facilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET REFERENCE
1	GS-II 23.01.02-1
2	GS-II 23.01.03-2
3	GS-II 23.01.08-3

LEVEL III KEY	GUIDE SHEET REFERENCE
1	GS-III 23.01.02-1
2	GS-III 23.01.03-2
3	GS-III 23.01.03-3
4*	GS-III 23.01.03-4*
5	GS-III 23.01.04-5
6*	GS-III 23.01.05-6*
7*	GS-III 23.01.05-7*
8*	GS-III 23.01.05-8*
9*	GS-III 23.01.05-9*
10	GS-III 23.01.05-10
11*	GS-III 23.01.08-11*
12	GS-III 23.01.10-12

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.01.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.01.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: HYDRANTS
CONTROL NUMBER: GS-II 23.01.08-3

Application

This guide applies to the investigation of leaking fire hydrants..

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Insure that main hydrant valve is closed and observe leakage.
2. Remove hose outlet cap and observe if water continues to run. Running water indicates that main valve gasket/seal is leaking.
3. Check operation of drip valve by opening main valve with outlets capped.
4. Shut main valve, open hose cap and observe if water drains from hydrant body.
5. Lack of drainage of water from the hydrant body indicates that drain valve is stopped up.
6. Return hydrant to normal service.

Recommended Inspection Frequency

The inspection when triggered by a level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Fire Protection Handbook, National Fire Protection Association

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.01.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.01.02-1

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.01.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.01.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions and reassemble control, if directed.
7. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section:

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.01.04-5

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-6*

Application

This guide applies to the investigation of leaks in underground potable water lines, triggered by customer complaint or suspected by extraordinary conditions observed in the normal course of operations.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
2. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion or soil or cave-ins).
3. Ensure system pressure is greater than 15 PSI.
4. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
5. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).
6. Double check your findings with ground microphone and probe attachment.
7. Report leak location for excavation and repair.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Electronic pipe indicator
2. Ground microphone (thumb tack) (probe)
3. Can of spray paint

Recommended Inspection Frequency

Perform this survey annually at the direction of the facility manager based on local factors and problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6* (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-6*

References

1. AWWA Water Audits and Leak Detectors, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-7*

Application

This guide applies to a leak survey of an underground potable water distribution system at the direction of the facility manager.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify public safety department of daily plans to block off roads, walkways and medians while conducting tests.
2. Provide safety equipment for crew members, e.g. safety vests, traffic cones and barricades.

Inspection Actions

Initial Survey

1. Determine time of day or night most effective to conduct listening survey.
2. Map out areas of survey, no more than two miles of line per day.
3. Ensure system pressure greater than 15 PSI.
4. Using high-frequency contact microphone, listen for leak sounds on all meters, valves, hydrants, blowoffs, air release valves and other contact points. Note the locations where water use, meter sounds or possible leak sounds exist. This is the initial survey.

Follow-up Survey

5. Return to each noted location of the initial survey. Using the high-frequency contact microphone, listen again for sounds. If the location is quiet, there is no leak. If you hear sounds and the meter is not running indicating water use, a leak probably exists.
6. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
7. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion of soil or cave-ins).
8. Ensure system pressure greater than 15 PSI.
9. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
10. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-7*

Inspection Actions (Continued)

Follow-up Survey (Continued)

11. Double check your findings with ground microphone and probe attachment.
12. Record leak location.
13. Gather all information as generated to submit reports on a scheduled basis.
14. Submit final report on findings and all data to facility manager for final action.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Up-dated distribution system map
2. Acoustic stethoscope
3. High-frequency contact microphone
4. Ground microphone with "thumb tack"
5. Electronic pipe locator
6. Ground microphone with extension probe
7. Spray paint

Recommended Inspection Frequency

Perform this survey every 3 to 5 years at the direction of the facility manager based on local factors and problematic conditions.

References

1. AWWA Water Audits and Leak Detectors, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-8*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-9*

Application

This guide applies to performing an efficiency check of the flow rate of the potable water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-10

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10 (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.01.05-10

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11*

COMPONENT: HYDRANTS
CONTROL NUMBER: GS-III 23.01.08-11*

Application

This guide applies to the sampling of the water quality at the most pressure distant point to determine the water quality, degradation and contamination. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review previous records on water sampling, tests results and changes to the distribution system.
2. Acquire a 50 ML sample of the potable water.
3. Perform a chemical analysis of the water sample.
4. Document results and submit a report to the facility manager.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section.

1. 50 ML container
2. Pressure gauge

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA

2. Operation and Maintenance of Centrifugal Units by Garth Denison CMS

3. The Locomotive, Hartford Steam Boiler Inspection & Insurance Co. Hartford, Conn., Vol. 66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12

COMPONENT: ENGINES
CONTROL NUMBER: GS-III 23.01.10-12

Application

This guide applies to the investigation of the source and cause of engine fuel, oil, or coolant leaks.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

Perform an investigation to determine the source of engine fuel, oil or coolant leaks.

1. Lockout the engine and perform an inspection of the engine.
2. Check the engine for any corrosion beyond repair, physical damage or missing components.
3. Inspect engine block and housing for stress cracks.
4. Inspect inspection plates, valve and crankcase covers, manifolds and oil filter cartridge for leaks.
5. Inspect fuel pump, injectors, fuel lines and fuel day tank for fuel leaks.
6. Inspect the radiator, coolant pump and hoses for leaks.
7. Return the engine and system to the normal condition.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Standard tools
2. As required for type and test being performed
3. Ladder

Recommender Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12 (Continued)

COMPONENT: ENGINES
CONTROL NUMBER: GS-III 23.01.10-12

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

DESCRIPTION

The Non-Potable Water Distribution System is a subsystem of the Infrastructure System. Non-potable water is used primarily for industrial purposes or as an emergency supply should there be a failure of the primary source. When a requirement for non-potable water exists, fire fighting water usually will be a part of the system. The distribution system is the network of pipes and pumps required to carry the water from its source to the using facility.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of Non-Potable Water Distribution Systems:

1. Hydrant Wrench
2. Pry Bar

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Non-Potable Water Distribution Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.02.01 PUMP BASE AND COUPLING
- ◆ 23.02.02 PUMPS
- ◆ 23.02.03 MOTORS
- ◆ 23.02.04 CONTROLS
- ◆ 23.02.05 PIPING AND FITTINGS
- ◆ 23.02.06 VALVES
- ◆ 23.02.07 FILTERS
- ◆ 23.02.08 HYDRANTS
- ◆ 23.02.09 MANHOLES
- ◆ 23.02.10 VALVE BOX - CONCRETE
- ◆ 23.02.11 VALVE BOX - BRICK, CMU OR STONE
- ◆ 23.02.12 VALVE BOX - STEEL

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

09	BUILDING FIRE PROTECTION

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Non-Potable Water System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.02.01 PUMP BASE AND COUPLING

The pump base is the mounting platform for the pump and motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective pump or motor mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
* **Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
* **Defective mounting hardware.**			
Observation:			
a. Loose tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.01 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective coupling guard.			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			
*** Corrosion (base).**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidence by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidence by holes or loss of base metal.	EA		
*** {Severity H}			
*** Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned, requiring proper disposal.	EA		
*** {Severity L}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.02 PUMPS

Pumps provide for water circulation throughout the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking at pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration at pump.**			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.03 MOTORS

Usually AC motors are used to drive the circulating pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.04 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel enclosures.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.05 PIPING AND FITTINGS

Piping and fittings provide the distribution network for the non-potable water distribution system. The distribution system is normally located underground, below the frost line. Where piping is exposed, hangers and supports are provided to with allowance for expansion and contraction.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water dripping.	EA		
*** {Severity M}			
c. Water streaming.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water dripping.	LF		
*** {Severity H}			
*** Defective above ground anchors or supports.**			
Observation:			
a. Improper size or loose.	EA		
*** {Severity L}			
b. Broken or missing.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation/jacket.	LF		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.05 PIPING AND FITTINGS (CONTINUED)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective galvanic anode cathodic protection systems.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent.	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
*** Corroded anchors or supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.02.05 PIPING AND FITTINGS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log. *** {Severity M}	EA		10
b. Disconnected or missing DC or AC power source. *** {Severity H}	EA		10
c. Zero reading on the meter. *** {Severity H}	EA		10

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.06 VALVES

Valves are normally used to isolate or direct the water flow.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
*** Damaged.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.07 FILTERS

A steel filtering tank provides a vessel for removing debris, vegetation, fish and other solid matter from the intake water. This is done by filtering through racks and filtering media.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Back-up or overflow of filter.	EA	3	
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.08 HYDRANTS

Hydrants are above ground extensions of the distribution system and are tied into the fire protection network. They are also used for flushing out sections of the system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged.**			
Observation:			
a. Missing hydrant caps, gaskets or chains	EA		
b. Broken or cracked hydrant. *** {Severity H}	EA		
*** Leakage.**			
Observation:			
a. Seepage, drips, main valve closed. *** {Severity M}	EA	4	
b. Steady leak. *** {Severity H}	EA	4	
*** Corrosion**			
Observation:			
a. Surface corrosion no pitting evident. *** {Severity L}	EA		
b. Corrosion evidenced by pitting or blistering. *** {Severity M}	EA		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	EA		

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.09 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of masonry units or prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged.**			
Observation:			
a. Bent/damaged frame/manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing cover.	EA		
*** {Severity H}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			
*** Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
c. Eroded joints (brick, CMU)	SF		
*** {Severity H}			
d. Loose, broken, missing brick or CMU.	SF		
*** {Severity H}			
*** Debris in manhole.**			
Observation:			
a. Sand/mud/debris in manhole.	EA		
*** {Severity M}			
b. Surcharged manhole.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.10 VALVE BOX - CONCRETE

A covered box either open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or spalling of concrete walls.**			
Observation:			
a. Wide cracks, between 1/16" and 1/4" wide.	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.02.10 VALVE BOX - CONCRETE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment with 2′ of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.11 VALVE BOX - BRICK, CMU OR STONE

A covered box either open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged brick, CMU or stone walls.**			
Observation:			
a. Cracked, split or damaged.	SF		
*** {Severity M}			
b. Loose or missing brick or stone.	SF		
*** {Severity H}			
* **Deteriorated mortar joint material.**			
Observation:			
a. Loose mortar joint material.	SF		
*** {Severity M}			
b. Missing mortar joint material.	SF		
*** {Severity H}			
* **Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2 in 4'.	SF		
*** {Severity H}			
* **Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.11 VALVE BOX - BRICK, CMU OR STONE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment with 2′ of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.02.12 VALVE BOX - STEEL

A covered box either open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Corrosion of steel box.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			
*** Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993
2. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
3. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials
4. Fire Protection Handbook, National Fire Protection Association

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET REFERENCE
1	GS-II 23.02.02-1
2	GS-II 23.02.03-2
3	GS-II 23.02.07-3
4	GS-II 23.02.08-4

LEVEL III KEY	GUIDE SHEET REFERENCE
1	GS-III 23.02.02-1
2	GS-III 23.02.03-2
3	GS-III 23.02.03-3
4*	GS-III 23.02.03-4*
5	GS-III 23.02.04-5
6*	GS-III 23.02.05-6*
7*	GS-III 23.02.05-7*
8*	GS-III 23.02.05-8*
9*	GS-III 23.02.05-9*
10	GS-III 23.02.05-10

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.02.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.02.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: FILTERS
CONTROL NUMBER: GS-II 23.02.07-3

Application

This guide applies to the investigation of back-up in a filter tank. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. All filters eventually become blocked or restricted and should have a schedule of cleaning, backflushing and rinsing.

Recommended Inspection Frequency

Refer to plant P.M. schedule.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: HYDRANTS
CONTROL NUMBER: GS-II 23.02.08-4

Application

This guide applies to the investigation of leaking fire hydrants..

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Insure that main hydrant valve is closed and observe leakage.
2. Remove hose outlet cap and observe if water continues to run. Running water indicates that main valve gasket/seal is leaking.
3. Check operation of drip valve by opening main valve with outlets capped.
4. Shut main valve, open hose cap and observe if water drains from hydrant body.
5. Lack of drainage of water from the hydrant body indicates that drain valve is stopped up.
6. Return hydrant to normal service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Fire Protection Handbook, National Fire Protection Association

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.02.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.02.02-1

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-2

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.02.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.02.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions and reassemble control, if directed.
7. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.02.04-5

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-6*

Application

This guide applies to the investigation of leaks in underground non-potable water lines, triggered by customer complaint or suspected by extraordinary conditions observed in the normal course of operations.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
2. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion or cave-ins).
3. Ensure system pressure is greater than 15 PSI.
4. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
5. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).
6. Double check your findings with ground microphone and probe attachment.
7. Report leak location for excavation and repair.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Electronic pipe indicator
2. Ground microphone (thumb tack) (probe)
3. Can of spray paint

Recommended Inspection Frequency

Perform this survey annually at the direction of the facility manager based on local factors and problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6* (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-6*

References

1. AWWA Water Audits and Leak Detectors, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-7*

Application

This guide applies to a leak survey of an underground non-potable water distribution system at the direction of the facility manager.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify public safety department of daily plans to block off roads, walkways and medians while conducting tests.
2. Provide safety equipment for crew members, e.g. safety vests, traffic cones and barricades.

Inspection Actions

Initial Survey

1. Determine time of day or night most effective to conduct listening survey.
2. Map out areas of survey, no more than two miles of line per day.
3. Ensure system pressure greater than 15 PSI.
4. Using high-frequency contact microphone, listen for leak sounds on all meters, valves, hydrants, blowoffs, air release valves and other contact points. Note the locations where water use, meter sounds or possible leak sounds exist. This is the initial survey.

Follow-up Survey

5. Return to each noted location of the initial survey. Using the high-frequency contact microphone, listen again for sounds. If the location is quiet, there is no leak. If you hear sounds and the meter is not running indicating water use, a leak probably exists.
6. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
7. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion of soil or cave-ins).
8. Ensure system pressure greater than 15 PSI.
9. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
10. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-7*

Inspection Actions (Continued)

Follow-up Survey (Continued)

11. Double check your findings with ground microphone and probe attachment.
12. Record leak location.
13. Gather all information as generated to submit reports on a scheduled basis.
14. Submit final report on findings and all data to facility manager for final action.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Up-dated distribution system map
2. Acoustic stethoscope
3. High-frequency contact microphone
4. Ground microphone with "thumb tack"
5. Electronic pipe locator
6. Ground microphone with extension probe
7. Spray paint

Recommended Inspection Frequency

Perform this survey every 3 to 5 years at the direction of the facility manager based on local factors and problematic conditions.

References

1. AWWA Water Audits and Leak Detectors, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-8*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-9*

Application

This guide applies to performing an efficiency check of the flow rate of the non-potable water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-10

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10 (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.02.05-10

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

23.03 STORM WATER COLLECTION SYSTEMS

DESCRIPTION

The Storm Water Collection System is a subsystem of the Infrastructure System. The storm water collection system is the network for collecting and disposing of rainwater runoff. There are two basic types, (1) an open system consisting of ditches/swales and culverts and (2) a closed system of catch basins, pipes and manholes. Combinations of the two are extensively used.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tool and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Storm Water Collection Systems:

1. Pry Bar

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section are, are necessary to perform the inspection of Storm Water Collection Systems.

If the inspector needs to physically enter a manhole or piping:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.03.01 ARROYOS, DITCHES AND SWALES
- ◆ 23.03.02 HEADWALLS, APRONS AND FLARED SECTIONS
- ◆ 23.03.03 PIPING
- ◆ 23.03.04 MANHOLES
- ◆ 23.03.05 INLETS AND CATCH BASINS
- ◆ 23.03.06 PUMP BASE AND COUPLING
- ◆ 23.03.07 PUMPS
- ◆ 23.03.08 MOTORS
- ◆ 23.03.09 CONTROLS

23.03 STORM WATER COLLECTION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

07.04 STORM WATER COLLECTION SYSTEMS

23.03 STORM WATER COLLECTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Storm Water Collection System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ **23.03.01 ARROYOS, DITCHES AND SWALES**

Arroyos, ditches and swales are long, relatively narrow water courses in the midst of generally level land. Arroyos are usually dry except after heavy rains. Swales are sometimes swampy and do not have the steep sides associated with arroyos and ditches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Watercourse restriction/blockage.**			
Observation:			
a. Vegetation, debris, nesting material or silt blocking less than 1/4 of watercourse cross section.	SF		
*** {Severity L}			
b. Vegetation, debris, nesting material or silt blocking from 1/4 to 1/2 of watercourse cross section.	SF		
*** {Severity M}			
* **Watercourse erosion.**			
Observation:			
a. Single isolated erosion of watercourse side less than 6" deep.	SF		
*** {Severity L}			
b. Occasional erosion areas along water-course sides less than 12" deep.	SF		
*** {Severity M}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.02 HEADWALLS AND FLARED END SECTIONS

Headwalls and flared pipe end sections direct water flow and provide earth stabilization at pipe inlets and outlets of piping networks and culverts.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Erosion.**			
Observation:			
a. Washout behind wing walls up to 6" in depth.	SF		
*** {Severity L}			
b. Washout behind wing walls greater than 6" in depth, not to foundation.	SF		
*** {Severity M}			
c. Washout of apron exposing apron toe at ditch flow line.	SF		
*** {Severity H}			
d. Washout to foundation or headwall broken away from pipe.	SF		
*** {Severity H}			
* **Growth and Debris.**			
Observation:			
a. Growth or debris on apron, obviously restricting flow.	SF		
*** {Severity L}			
* **Wall and Apron Damage.**			
Observation:			
a. Cracked or spalled concrete, reinforcing not exposed.	SF		
*** {Severity M}			
b. Cracked, eroded mortar joints in brick, CMU or stone walls.	SF		
*** {Severity M}			
c. Exposed concrete, reinforcing steel.	SF		
*** {Severity H}			
d. Loose or missing brick, CMU or stone.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.02 HEADWALLS AND FLARED END SECTIONS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion (Metal Flared End Sections)**			
Observation:			
a. Missing protective coating - galvanized/bitumen.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting and blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by hole or severe loss of base metal.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.03 PIPING

The piping network ties all the sources and inlets of storm water together and transports the flow to rivers, lakes, ponds or other reservoirs. A culvert is a drainage pipe, usually traversing a roadway or embankment. Piping may be concrete or metal.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged joint fittings.**			
Observation:			
a. Sink holes over pipe, indicating leaking or damaged pipe joint.	SF		1
*** {Severity M}			
b. Open, bent or misaligned pipe joints.	EA		1
*** {Severity H}			
*** Restricted flow.**			
Observation:			
a. Silt or debris raising flow line/ invert 10% to 25% of pipe diameter.	LF		
*** {Severity M}			
b. Silt or debris raising flow line/ invert greater than 25% of pipe diameter.	LF		
*** {Severity H}			
*** Corrosion (metal pipe).**			
Observation:			
a. Missing protective coating - galvanized/bitumen.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting and blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by hole or severe loss of base metal.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.03 PIPING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged Pipe Sections.**			
Observation:			
a. Pipe settled out of gradient from 10% to 25% of pipe diameter.	LF		1
*** {Severity M}			
b. Pipe settled out of gradient greater than 25% of pipe diameter.	LF		1
*** {Severity H}			
c. Pipe crushed or broken.	LF		1
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.04 MANHOLES

Manholes are inspection and maintenance accesses positioned at critical connection points in the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged.**			
Observation:			
a. Bent/damaged frame or manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity S}			
c. Missing rungs.	EA		
*** {Severity S}			
d. Missing manhole cover.	EA		
*** {Severity S}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			
*** Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
c. Eroded joints (brick, CMU)	SF		
*** {Severity H}			
d. Loose, broken, displaced brick or CMU.	SF		
*** {Severity H}			
*** Deteriorated protective coating.**			
Observation:			
a. Peeling or blistering area of protective coating.	SF		
*** {Severity M}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.04 MANHOLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Debris in manhole.**			
Observation:			
a. Sand/mud/debris in manhole.	EA		
*** {Severity M}			
b. Sewer pipe fragments in manhole (indicating broken pipe).	EA		
*** {Severity H}			
c. Pipe fragments in manhole (indicating broken pipe).	EA		
*** {Severity H}			
d. Surcharged manhole.	EA		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.05 INLETS AND CATCH BASINS

Inlets and catch basins are located at low points to intercept the runoff and introduce it into the piping system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Restricted flow.**			
Observation:			
a. Debris, obstructions blocking inlet.	EA		
*** {Severity M}			
b. Physically damaged, crushed or broken chunks blocking inlet.	EA		
*** {Severity H}			
c. Surcharged.	EA		
*** {Severity H}			
*** Damaged/missing grate.**			
Observation:			
a. Bent, distorted or loose frame or cover.	EA		
*** {Severity M}			
b. Broken rungs.	EA		
*** {Severity H}			
c. Missing cover.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.06 PUMP BASE AND COUPLING

The pump base is the mounting platform for the pump or motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective pump or motor mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.06 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion (base).**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidence by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidence by holes or loss of base metal.	EA		
*** {Severity H}			
* **Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned, requiring proper disposal.	EA		
*** {Severity L}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.07 PUMPS

Pumps provide for water transfer through the system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking at pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration at pump.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.08 MOTORS

Usually AC motors are used to drive the lift pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	4
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	4
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.03.09 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		6
*** {Severity H}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel enclosures.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.03 STORM WATER COLLECTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993
2. AWWA Nondestructive Testing of Watermains for Physical Integrity, 1992
3. Architectural Graphic Standards, Seventh Edition, Ramsey/Sleeper, 1981

23.03 STORM WATER COLLECTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.03.07-1
2	GS-II 23.03.08-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.03.03-1
2*	GS-III 23.03.03-2*
3	GS-III 23.03.07-3
4	GS-III 23.03.08-4
5	GS-III 23.03.08-5
6	GS-III 23.03.09-6

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.03.07-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.03.08-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING
CONTROL NUMBER: GS-III 23.03.03-1

Application

This guide applies to the investigation of the interior of piping (less than 48") for leaks, separations, cracks and obstruction.

Special Safety Requirements

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section.

If the inspector needs to physically enter a manhole or sewer piping:

a. Notify Safety and Facility Engineering personnel and receive the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

Inspection Actions

1. Isolate suspected defect area by visual means (seepage, grass, growth, etc.).
2. Enter manhole upstream of defect.
3. If straight pipe to the next manhole, shine a light through. If beam projected is less than a circle, obstruction exists.
4. Insert vehicle carrying video camera and travel it through the line. The vehicle can be self propelled or pulled through by a wire cable.
5. Record results and close up system.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Vehicle (self propelled or pulled through)
2. Video camera

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PIPING
CONTROL NUMBER: GS-III 23.03.03-1

References

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993
2. AWWA Nondestructive Testing of Watermains for Physical Integrity, 1992
3. TRI-State Utilities, Chesapeake VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: PIPING
CONTROL NUMBER: GS-III 23.03.03-2*

Application

This guide applies to detecting leaks and infiltration in underground storm water collection lines by smoke testing.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify facility security and safety sections of the times and locations of the tests.
2. Provide safety equipment for crew members, i.e. safety vests, traffic cones and barricades if test locations are in traffic areas.

Inspection Actions

1. A written notice explaining "smoke test" should be issued to all occupants of the test area.
2. Prepare basic smoke sketch.
3. Isolate line sections to be tested, maximum 1,000 feet at a time.
4. Smoke bombs or canisters (normally 3-5 minutes duration) are used to generate a non-toxic, odorless, non-staining smoke that does not create a fire hazard.
5. An air blower is used to force the smoke into the sewer pipes. A gasoline-driven blower, minimum capacity 3,200 CFM is the most convenient for this purpose.
6. Smoke should be generated continuously while visual inspection and photography is in progress.
7. Walk entire area, front and back yards and around buildings. Watch for smoke from any source.
8. Photograph all leaks discovered. Be sure to include identifiable background. Locate the leaks on the sketch.

CAUTION: 1) This test is ineffective on windy days, rainy days, or snowy days.
2) Smoke will not penetrate frozen ground or areas where the soil surrounding the pipe is saturated.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2* (Continued)

COMPONENT: PIPING
CONTROL NUMBER: GS-III 23.03.03-2*

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Smoke bombs or canisters
2.. Gasoline-driven blower (3,200 CFM minimum)
3. Cameras

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. Hampton Roads Sanitation District, Virginia Beach, Virginia.

2. ASCE-WPCF Existing Sewer Evaluation and Rehabilitation, 1983.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.03.07-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.03.07-3

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.03.08-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.03.08-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.03.08-5

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.03.08-5

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.03.09-6

Application

This guide applies to the investigation of electrical arcing noise from the controls, if motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions and reassemble control, if directed.
7. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section:

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.03.09-6

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

23.04 SANITARY SEWER COLLECTION SYSTEMS

DESCRIPTION

The Sanitary Sewer Collection System is a subsystem of the Infrastructure System. The sanitary sewer collection system provides for the collection and disposal of a facilities domestic waste products. Sources include all domestic plumbing fixtures, floor drains, and other area drains.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Sanitary Sewer Collection Systems:

1. Pry Bar

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Sanitary Sewer Collection Systems.

If the inspector needs to physically enter a manhole or sewer piping:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.04.01 PUMP BASE AND COUPLING
- ◆ 23.04.02 PUMPS
- ◆ 23.04.03 MOTORS
- ◆ 23.04.04 SEWAGE EJECTORS
- ◆ 23.04.05 CONTROLS
- ◆ 23.04.06 PIPING AND FITTINGS
- ◆ 23.04.07 MANHOLES/CLEANOUTS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

07.03 SANITARY COLLECTION SYSTEMS

23.04 SANITARY SEWER COLLECTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Sanitary Sewer Collection System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.04.01 PUMP BASE AND COUPLING

The pump base is the mounting platform for the pump and motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective pump or motor mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS

◆ 23.04.01 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing coupling guard.	EA		
*** {Severity H}			
*** Corrosion (base).**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidence by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidence by holes or loss of base metal.	EA		
*** {Severity H}			
*** Abandoned pump assembly (Disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned, requiring proper disposal.	EA		
*** {Severity L}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.02 PUMPS

Pumps provide for waste fluid evacuation from one elevation level to another.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking at pump fitting or seals.	EA		
*** {Severity H}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration at pump.**			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.03 MOTORS

Usually AC motors are used to drive the lift pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.04 SEWAGE EJECTORS

A sewage ejector system has a tank or pit which receives sewage or liquid waste and is emptied by sewage ejectors. Pneumatic ejectors are frequently utilized in place of pumps to facilitate the movement of wastewater influent from the wet well or collection sumps to the sewage plant treatment facilities. The most common ejectors use compressed air as a prime mover.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or spalling of pit concrete.**			
Observation:			
a. Cracks greater than 1/4"	SF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reenforcing steel.	SF		
*** {Severity H}			
*** Out of plumb.**			
Observation:			
a. Less than or equal to 3" in 8'.	SF		
*** {Severity M}			
b. Greater than 3" in 8'.	SF		
*** {Severity H}			
*** Deteriorated concrete pit joint sealant/caulk.**			
Observation:			
a. Cracked joint sealant/caulk.	LF		
*** {Severity L}			
b. Loose/missing joint sealant/caulk.	LF		
*** {Severity H}			
*** Loose/missing cover/grate.**			
Observation:			
a. Loose cover or grate.	EA		
*** {Severity L}			
b. Missing or damaged cover or grate.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS

◆ 23.04.04 SEWAGE EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion of steel tank.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evident by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evident by holes or loss of base metal.	SF		
*** {Severity H}			
*** Loose/missing pump or motor mounting hardware.**			
Observation:			
a. Loose pump or motor tie-down bolts.	EA		
*** {Severity M}			
b. Missing pump or motor tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective ejector.**			
Observation:			
a. Control system failure.	EA		
*** {Severity H}			
b. Loss of air pressure.	EA		
*** {Severity F}			
c. Surcharged tank or pit.	EA		
*** {Severity H}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS

◆ 23.04.04 SEWAGE EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	3	5
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	3	5
*** {Severity H}			
c. Electrical arcing noise.	EA		6
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Physically damaged controls.**			
Observation:			
a. Missing controls.	EA		
*** {Severity M}			
b. Loose controls.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS

◆ 23.04.04 SEWAGE EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.05 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		7
*** {Severity H}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel enclosures.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.06 PIPING AND FITTINGS

Piping and fittings provide the drainage network for the sanitary sewer collection system, with the final destination being the sewage treatment plant.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Restricted flow.**			
Observation:			
a. Reduced, restricted flow.	LF		
*** {Severity M}			
b. Blocked flow.	LF		8
*** {Severity H}			
* **Defective joint fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity H}			
b. Waste water leaking into/out, seepage, infiltration.	EA		
*** {Severity H}			
c. Broken joint fitting.	EA		8
*** {Severity H}			
* **Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity H}			
b. Waste water leaking into/out, seepage, infiltration.	LF		8
*** {Severity H}			
c. Broken pipe.	LF		8
*** {Severity H}			
* **Corroded piping.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.07 MANHOLES/CLEANOUTS

Manholes are inspection and maintenance accesses positioned at critical connection points in the collection system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated walls/bottom/roof.**			
Observation:			
a. Hairline cracks, no water leaking.	SF		
*** {Severity L}			
b. Wide cracks, visible water leakage.	LF		
*** {Severity H}			
c. Exposed reinforcing.	SF		
*** {Severity H}			
d. Eroded joints (brick, CMU).	LF		
*** {Severity H}			
e. Loose, broken, displaced brick or CMU.	SF		
*** {Severity H}			
*** Deteriorated protective coating.**			
Observation:			
a. Peeling or blistering area of protective coating.	SF		
*** {Severity M}			
*** Debris in manhole.**			
Observation:			
a. Sand/mud/debris in manhole.	EA		
*** {Severity M}			
b. Sewer pipe fragments in manhole (indicating broken pipe).	EA		
*** {Severity H}			
c. Surcharged manhole.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

COMPONENTS (Continued)

◆ 23.04.07 MANHOLES/CLEANOUTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Physically damaged.**			
Observation:			
a. Bent/damaged frame or manhole cover.	EA		
*** {Severity S}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity S}			
c. Missing rungs.	EA		
*** {Severity S}			
d. Missing manhole/cleanout covers.	EA		
*** {Severity S}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			

23.04 SANITARY SEWER COLLECTION SYSTEMS

REFERENCE

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. 2 Inspection of Shore Facilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials
6. Existing Sewer Evaluation and Rehabilitation, American Society of Civil Engineering
Practice No. 62, WPCF-Manual of Practice FD-6, 1983

23.04 SANITARY SEWER COLLECTION SYSTEMS

LEVEL II KEY:	GUIDE SHEET REFERENCE
1	GS-II 23.04.02-1
2	GS-II 23.04.03-2
3	GS-II 23.04.04-3

LEVEL III KEY:	GUIDE SHEET REFERENCE
1	GS-III 23.04.02-1
2	GS-III 23.04.03-2
3	GS-III 23.04.03-3
4*	GS-III 23.04.03-4*
5	GS-III 23.04.04-5
6	GS-III 23.04.04-6
7	GS-III 23.04.05-7
8	GS-III 23.04.06-8
9*	GS-III 23.04.06-9*
10*	GS-III 23.04.06-10*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.04.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.04.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: SEWAGE EJECTORS
CONTROL NUMBER: GS-II 23.04.04-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.04.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.04.02-1

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. MEANS Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megohmmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.04.03-4*

Recommended Inspection Frequency

Annually

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: SEWAGE EJECTORS
CONTROL NUMBER: GS-III 23.04.03-5

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: SEWAGE EJECTORS
CONTROL NUMBER: GS-III 23.04.03-5

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. MEANS Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: SEWAGE EJECTORS
CONTROL NUMBER: GS-III 23.04.04-6

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor bearings.
4. Shut down motor, tag and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, sings or overheating and loose fasteners.
7. Check commuter/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding and rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: SEWAGE EJECTORS
CONTROL NUMBER: GS-III 23.04.04-6

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.04.05-7

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions and reassemble control, if directed.
7. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.04.05-7

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.04.06-8

Application

This guide applies to the investigation of the interior of piping less than 48" DIA for leaks, separations, cracks and obstructions.

Special Safety Requirements

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of the Sanitary Sewer Distribution System.

If the inspector needs to physically enter a manhole or sewer piping:

a. Notify Safety and Facility Engineering personnel and receive the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

Inspection Actions

1. Isolate suspected defect area by visual means (seepage, roots, grass growth, etc.)
2. Enter manhole upstream of defect.
3. If pipe is straight to the next manhole, shine a light beam through. If beam projected is less than a circle, obstruction exists.
4. Insert a vehicle carrying the video camera and have it travel through the pipeline. The vehicle can be self-propelled or pulled through by a cable.
5. Record results and close up system.

Special Tools and Equipment

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the sub-system:

1. Video camera
2. Camera vehicle

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.04.06-8

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol II Inspection of Shore Facilities, 1993
2. Existing Sewer Evaluation and Rehabilitation, American Society of Civil Engineering Practice No. 62, WPCF-Manual of Practice FD-6, 1983.
3. Tri-State Utilities; Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.04.06-9*

Application

This guide applies to detecting leaks and infiltration in underground sanitary sewer lines by smoke testing.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify facility security and safety sections of the times and locations of the tests.
2. Provide safety equipment for crew members, i.e. safety vests, traffic cones and barricades if test locations are in traffic areas.

Inspection Actions

1. A written notice explaining "smoke test" should be issued to all occupants of the test area.
2. Prepare basic smoke sketch.
3. Isolate line sections to be tested, maximum 1,000 feet at a time.
4. Smoke bombs or canisters (normally 3-5 minutes duration) are used to generate a non-toxic, odorless, non-staining smoke that does not create a fire hazard.
5. An air blower is used to force the smoke into the sewer pipes. A gasoline-driven blower, minimum capacity 3,200 CFM is the most convenient for this purpose.
6. Smoke should be generated continuously while visual inspection and photography is in progress.
7. Walk entire area, front and back yards and around buildings. Watch for smoke from any source.
8. Photograph all leaks discovered. Be sure to include identifiable background. Locate the leaks on the sketch.

CAUTION: 1) This test is ineffective on windy days, rainy days, or snowy days.
2) Smoke will not penetrate frozen ground or areas where the soil surrounding the pipe is saturated.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Smoke bombs or canisters
2. Gasoline-driven blower (3,200 CFM minimum)
3. Cameras

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9* (Continued)

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.04.06-9*

Recommended Inspection Frequency

Every 5 years at the direction of the facility manager.

References

1. Hampton Roads Sanitation District, Virginia Beach, VA

2. ASCE-WPCF Existing Sewer Evaluation and Rehabilitation, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10*

COMPONENT: PIPING AND FITTINGS
CONTROL NUMBER: GS-III 23.04.06-10*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

DESCRIPTION

The Chilled Water Distribution System is a subsystem of the Infrastructure System. The chilled water distribution system circulates chilled water from the central cooling plant to designated building chilled water systems and back to the central cooling plant. The routing of the piping can be above ground, underground or a combination of both.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Chilled Water Distribution Systems:

1. Scraper
2. Wire brush
3. Calipers
4. Measuring scales
5. Hammer
6. Ice pick or pocket knife
7. Pry bar
8. 1/2" Drive socket set

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Chilled Water Distribution Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENT LIST

- 23.05.01 PUMP BASE AND COUPLING
- 23.05.02 PUMPS
- 23.05.03 MOTORS
- 23.05.04 CONTROLS
- 23.05.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND
- 23.05.06 PIPING, FITTINGS AND VALVES - UNDERGROUND
- 23.05.07 MANHOLES
- 23.05.08 VALVEBOX - CONCRETE
- 23.05.09 VALVEBOX - BRICKS, CMU OR STONE
- 23.05.10 VALVEBOX - STEEL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

08.15	CHILLED WATER DISTRIBUTION SYSTEMS
17.01	TUNNEL STRUCTURE
17.02	TUNNEL DRAINAGE
32.05	CHILLED WATER DISTRIBUTION SYSTEMS

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Chilled Water Distribution System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.05.01 PUMP BASE AND COUPLING.

The pump base is the mounting platform for the pump and motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective pump or motor mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
* **Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
* **Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.05.01 PUMP BASE AND COUPLING (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
*** Corrosion (base).**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned, requiring proper disposal.	EA		
*** {Severity L}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.02 PUMPS

Pumps provide for chilled water circulation throughout the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking at pump fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Missing or damaged insulation.	SF		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.03 MOTORS

Electric motors are used to drive the circulating pumps. In-line circulating pumps are typically driven via spring-coupled motors, pedestal-mounted pumps are typically driven via rigid or flex-coupled motors.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.04 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel enclosure.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND

Piping and fittings provide the distribution network for the chilled water system that is above ground level. Valves are installed to control the chilled water supply, isolate system parts and provide a means for drainage.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
*** Defective guides or anchors.**			
Observation:			
a. Loose guides or anchors.	EA		
*** {Severity L}			
b. Broken or missing guides or anchors.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective support poles - wood.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8'.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8'.	EA		
*** {Severity H}			
d. Split, rot or parasite deteriorated cross section support members.	EA	3	6
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective support poles - concrete.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8'.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8'.	EA		
*** {Severity H}			
d. Cracking, scaling or spalling deteriorated cross section support members.	EA		7
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective support poles - metal.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8'.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8'.	EA		
*** {Severity H}			
d. Cracking, buckling or stress deformation of support members.	EA		8
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity M}			
*** Corroded piping and fittings**			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Defective pipe labeling.**			
Observation:			
a. Damaged/missing labels.	EA		
*** {Severity L}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.06 PIPING, FITTINGS AND VALVES - UNDERGROUND

Piping and fittings provides the network for the chilled water distribution system. The underground network consist of following types:

Conduit systems are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems are designed to permit drainage of the conduit in place and to permit drying of the insulation if the system is flooded.

Tile conduit and concrete trenches are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems have rigid pipe supports, insulation, air space and sloped bases for complete drainage.

Walking tunnels are similar to concrete trenches except that they are sufficiently large to permit personnel walking through it for inspection or repairs.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.06 PIPING AND FITTINGS - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
* **Defective galvanic anode cathodic protection systems.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
* **Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged/missing insulation.	SF		
*** {Severity H}			
* **Corroded piping and fittings.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.06 PIPING AND FITTINGS - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Defective labeling/color.**			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity L}			
*** Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log.	EA		14
*** {Severity M}			
b. Disconnected or missing DC or AC power source.	EA		14
*** {Severity H}			
c. Zero reading on the meter.	EA		14
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.07 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective Manhole cover or ladder.**			
Observation:			
a. Bent/damaged frame/manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing manhole cover.	EA		
*** {Severity H}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			
*** Defective drainage.**			
Observation:			
a. Debris in manholes.	EA		
*** {Severity M}			
b. Malfunctioning gravity drain.	EA		
*** {Severity M}			
c. Inoperable or missing float controls.	EA		
*** {Severity H}			
d. Inoperable or missing sump pump.	EA		
*** {Severity H}			
e. Surcharged manhole.	EA		
*** {Severity H}			
*** Defective conduit/end caps.**			
Observation:			
a. Defective welds at conduit end cap.	LF		
*** {Severity M}			
b. Missing conduit vent pipe.	LF		
*** {Severity M}			
c. Missing conduit drain plug.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.07 MANHOLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
* **Corrosion of steel wall/bottom/roof.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
* **Defective manhole ventilation.**			
Observation:			
a. Damaged vent pipe.	LF		
*** {Severity L}			
b. Missing vent pipe.	LF		
*** {Severity H}			
c. Clogged vent holes.	EA		
*** {Severity F}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.08 VALVE BOX - CONCRETE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or spalling of concrete walls.**			
Observation:			
a. Wide cracks, between 1/16" and 1/4" wide.	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.08 VALVE BOX - CONCRETE Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharge valvebox.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.09 VALVE BOX - BRICK, CMU OR STONE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged brick, CMU or stone walls.**			
Observation:			
a. Cracked, split or damaged.	SF		
*** {Severity M}			
b. Loose or missing brick or stone.	SF		
*** {Severity H}			
*** Deteriorated mortar joint material.**			
Observation:			
a. Loose mortar joint material.	SF		
*** {Severity M}			
b. Missing mortar joint material.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.05.09 VALVE BOX - BRICK, CMU OR STONE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve. *** {Severity M}	CF		
b. Valvebox full of debris/sediment. *** {Severity H}	CF		
c. Surcharged valvebox. *** {Severity H}	EA		

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.05.10 VALVE BOX - STEEL

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Corrosion of steel box.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			
*** Valve box full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. U.S. Corps of Engineers EP415-1-261, Vol. 4, Quality Assurance Representative's Guide
6. USACERL TR M-91/01, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.05.02-1
2	GS-II 23.05.03-2
3	GS-II 23.05.05-3

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.05.02-1
2	GS-III 23.05.03-2
3	GS-III 23.05.03-3
4*	GS-III 23.05.03-4*
5	GS-III 23.05.04-5
6	GS-III 23.05.05-6
7	GS-III 23.05.05-7
8	GS-III 23.05.05-8
9	GS-III 23.05.05-9
10*	GS-III 23.05.05-10*
11*	GS-III 23.05.06-11*
12*	GS-III 23.05.06-12*
13*	GS-III 23.05.06-13*
14	GS-III 23.05.06-14

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.05.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.05.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-II 23.05.05-3

Application

This guide applies to the investigation of deterioration of wood support poles of piping, fittings and valves due to insect infestation, rot or fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.05.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.05.02-1

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.05.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.05.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating. Tag and lock out disconnect.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.05.04-5

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-6

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings and valves due to insect infestation, rot and fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Sound with hammer.
2. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
3. Test with a moisture meter.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-7

Application

This guide applies to the investigation of cracks in concert support poles of above ground piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and height.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-8

Application

This guide applies to the investigation of cracks and cracked welds in metal support poles of above ground piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.
4. Perform NDT, in this case high frequency ultrasonic inspection of the cracks to determine extent of subsurface damage.
5. Check any other suspect areas such as patches and repairs.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire brush
2. Dye penetrant and developer
3. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-9

Application

This guide applies to the use of ultrasonic testing equipment to investigate the interior of piping for leaks, cracks and separations. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of the Potable Water Distribution System.

1. Notify affected personnel and obtain permission to take piping out of service.
2. Acquire confined space entry permit from base safety officer.
3. Always have one person standing buy outside when someone is working inside a confined space.

Inspection Actions

1. Isolate the pipe section.
2. Perform the ultrasonic test on pipe section.
3. Document the readings and compare to wall thickness of piping in ASTM manual to determine of piping is defective or damaged.
4. Return pipe to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic testing equipment
2. Test vehicle (Smart Pig)

Recommended Inspection Frequency

Perform inspection when triggered by level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-9

References

1. NAVFAC MO-322, Vol 2, Inspection of Shore Facilities, 1993

2. Nondestructive Testing of Water Mains for Physical Integrity. American Water Works Association. ISBN 0-89867-620-7. 1992

3. Water Audits and Leak Detection, Manual of Water Supply Practices, American Water Works Association, AWWA M36, 1990

4. Tri-State Utilities, Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10*

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.05.05-10*

Application

This guide applies to performing an efficiency check of the flow rate of the chilled water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-11*

Application

This guide applies to the investigation of leaks in underground chilled water distribution lines, triggered by customer complaint or suspected by extraordinary conditions observed in the normal course of operations.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
2. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion or soil or cave-ins).
3. Ensure system pressure is greater than 15 PSI.
4. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
5. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).
6. Double check your findings with ground microphone and probe attachment.
7. Report leak location for excavation and repair.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Electronic pipe indicator
2. Ground microphone (thumb tack) (probe)
3. Can of spray paint

Recommended Inspection Frequency

Perform this survey annually at the direction of the facility manager based on local factors and problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11* (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-11*

References

1. AWWA Water Audits and Leak Detection, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-12*

Application

This guide applies to the use of compressed air to test the casing integrity of the pressure testable conduit system. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This procedure is not applicable for tile conduit systems, corrugated conduit systems or any concrete trench systems.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to perform the test.
2. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Check to be sure conduit end plates properly seal the conduit.
2. Pressurize the air space in the conduit to 15 PSI using the drain plug or vent pipe opening in the end plate as a connection for the air compressor hose.
3. Cut off compressor.
4. Record readings of the air pressure inside the conduit every ten minutes for a minimum of one hour.
5. Reinstall the drain plug and or vent pipe in the end plate as necessary.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Portable air compressor and hose
2. Pressure gauge

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the conduit system. If there is no manufacturer's recommendation an inspection should be performed on a five year cycle or whenever the desired degree of reliability justifies the procedure.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12* (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-12*

References

1. USACERL TR M-91/01, March 1991, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-13*

Application

This guide applies to performing an efficiency check of the flow rate of the chilled water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-14

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14 (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.05.06-14

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

23.06 ELEVATED WATER STORAGE TOWERS

DESCRIPTION

An Elevated Water Storage Tower is a Subsystem of the Infrastructure System. The Elevated Water Storage Tower serves several major functions. The primary purpose is to provide a ready supply of water to meet consumption needs of various users. The secondary function is to provide a means for pressurizing the water distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains. Elevated Water Storage Towers typically fall within two basic types of construction. The first is the 'Tower Supported' type which includes several legs to support and stabilize the tank section. The other type is the 'Pedestal' type which is characterized by its lack of support legs with only a main central support shaft between the ground and the tank section. Due to the height to which the towers are constructed, many are fitted with obstruction lights to alert aircraft to their presence. Many also serve as support platforms for rotating airfield beacons as well as minor communication antennas. Construction materials may be steel or concrete.

LIFE CYCLE

STEEL WATER TOWERS	50 YRS
CONCRETE WATER TOWERS	40 YRS

Source:
Chicago Bridge and Iron Co., tank fabricators and erectors.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following special tools shall be employed during the inspection of the elevated water storage tower;

1. Climbing Harness if subsystem is so equipped,
2. Binoculars, 7X10 Power Ocular.

Other special tools and equipment may be required to perform inspections of related systems. Refer to the appropriate DS/IM for guidance.

SPECIAL SAFETY REQUIREMENTS

Prior to inspection of a water storage tower, the authority having jurisdiction such as the Facility Manager shall be notified so as to secure proper access, provide safety instructions as required and furnish climbing harness as applicable. Two persons are required to perform the inspection when climbing is involved. Inspection shall not be conducted during periods of inclement weather.

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS

- 23.06.01 CONCRETE FOUNDATIONS
- 23.06.02 STRUCTURAL STEEL SUPPORTS
- 23.06.03 STEEL LADDERS/PLATFORMS
- 23.06.04 STEEL RISER PIPE
- 23.06.05 STEEL TANK SHELL PLATES
- 23.06.06 OVERFLOW PIPING/VENTS
- 23.06.07 CONCRETE TANKS AN PEDESTALS
- 23.06.08 ALTITUDE VALVES
- 23.06.09 CATHODIC PROTECTION

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following DS/IM's should be reviewed for concurrent inspection activities.

13.01 FENCING AND GATES
23.01 POTABLE WATER DISTRIBUTION SYSTEM
29.06 EXTERIOR LIGHTING SYSTEM
29.07 LIGHTNING PROTECTION SYSTEM

23.06 ELEVATED WATER STORAGE TOWERS

STANDARD INSPECTION PROCEDURE

The standard Inspection involves a visual examination of each component present. In some cases a more in depth inspection is indicated by a "Level II" Key notation for a given defect/Observation. The standard inspection should be carried out in the order of presentation of the various components. Associated defects and observations are listed which will be presented in the inspector's Field CAIS. The standard inspection does not include an inspection of the interior of the water storage tank. A Level III inspection Guide Sheet is provided for the more advanced procedures used when inspecting the interior of Water tank.

The Inspection Unit (IU) for this subsystem is defined at the component level. For additional guidance in defining an IU refer to the Infrastructure (System) Inspector's Guide, Section IV.

COMPONENTS

◆ 23.06.01 CONCRETE FOUNDATIONS

Concrete Foundations convey the bearing load from the structure to the soil. Concrete is typically cast-in-place. Concrete is a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate. In Portland cement concrete, the binder is a mixture of Portland cement and water.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Surface Deterioration:**			
Observation:			
a. Cracks greater than 1/16" in width.	LF		
*** {Severity L}			
b. Spalling.	SF		
*** {Severity M}			
c. Efflorescence.	SF		
*** {Severity M}			
d. Exposed reinforcing steel.	SF		
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.02 STRUCTURAL STEEL SUPPORTS

Standard I-Beam Shape Supports:

An I-beam is a structural member of rolled steel with a cross-section that resembles the capital letter I. In former years built-up sections were used extensively, but wide flange sections are now rolled in a large variety of sizes and are used universally because they require minimal fabrication. For excessive loads or unusual conditions, plates are welded to the flanges of wide flange sections to give added strength.

Structural Tube Beam Supports:

Steel beams are also fabricated from structural tubing in both square and rectangular shapes and can be used for light to moderate weight structural framing. Sections are produced with various thicknesses, thus allowing a considerable range of structural capacities.

Steel Pipe Supports:

Steel Pipe may be used as tubular structural members. Steel pipe is available in many different wall thicknesses making it suitable for many applications.

Connections:

Connections are commonly provided by bolting, riveting, welding, or by a combination of shop-welding and field-bolting. Bolts may be common or high strength.

High-strength bolts may be specified with friction or bearing-type connections with threads included or excluded from the shear plane. Connection details vary with type and number.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
*** {Severity L}			
b. Moderate corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Severe corrosion evidenced by holes or loss of base metal.	SF		1
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.02 STRUCTURAL STEEL SUPPORTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Damage:**			
Observation:			
a. Impact damage, dents.	EA		
*** {Severity L}			
b. Abrasions.	EA		
*** {Severity L}			
c. Out of alignment or bowing.	EA		
*** {Severity H}			
*** Damaged Connections:**			
Observation:			
a. Fasteners that do not appear tight/snug.	EA		
*** {Severity M}			
b. Broken Welds.	EA		
*** {Severity H}			
c. Missing fasteners.	EA		
*** {Severity H}			
*** Loss of Protective Coating/Paint:**			
Observation:			
a. Scraped/chipped paint.	SF		
*** {Severity L}			
b. Chalked paint.	SF		
*** {Severity L}			
c. Blistered paint.	SF		2
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.03 STEEL LADDERS/PLATFORMS

Ladders are used to provide access to the tank and balcony platforms. On Tower Supported type tanks, a ladder is typically located along one of the support legs and ends at a balcony platform adjacent to the tank shell. A ladder from the balcony continues on the outside of the tank shell and provides access to the top of the tank. An internal tank ladder may be installed providing access from roof hatches to the tank interior. On Pedestal type tanks, the ladder is concealed within the support shaft. The ladder continues through the tank shell to the tank roof hatch. A manhole is located just below the tank roof to provide access to the interior of the tank.

Fabricated ladders should comply with all applicable OSHA requirements. Specific details, and anchorages typically follow the manufacturer's specifications.

Siderails are usually continuous steel flat bars, 3/8 x 2 inches minimum, with eased edges, spaced approximately 16 inches apart. Fabricated ladders typically have bar rungs that are round or square steel bars or shapes, 3/4 inch in diameter or surface dimension, spaced about 12 inches on-center. The supports at each ladder are at the top and bottom and at the intermediate points typically spaced not more than 5 feet on-center by welded or bolted steel brackets.

Brackets are used to support the design and live loads of the ladder and to maintain a uniform distance between the centerline of ladder rungs and the wall surface.

A non-slip surface is sometimes applied to the top of each rung. The non-slip surface may be aluminum oxide granules set in epoxy resin adhesive, or a manufactured type of non-slip surface rung filled with aluminum oxide grout.

Ladder Safety Cages:

Fabricated safety cages must comply with all applicable OSHA requirements. The safety cage is attached to the ladder assembly by welding, bolting or riveting. The primary hoops are typically made of steel bars that are 5/16 x 4 inches for top, bottom, and cages longer than 20 feet, intermediate bars spaced no more than 20 inches on-center. The secondary intermediate hoops are also usually made of steel bars that are 5/16 x 2 inches. Hoops are spaced no more than 4 feet on-center between primary hoops. The vertical bars are made of steel that is 5/16 X 2 inch, secured to each hoop, and spaced approximately 9 inches on-center. A safety device may be installed on the ladder system to engage a climbing harness to prevent falls.

Platforms:

Platforms and balconies are typically constructed of open metal grating. Hand rails are typically constructed from steel pipe securely attached to the platforms.

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ **23.06.03 STEEL LADDERS/PLATFORMS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion:**			
Observation:			
a. Light surface corrosion (no pitting evident).	SF		
*** {Severity L}			
b. Moderate corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Severe corrosion evidenced by holes or loss of base metal.	SF		3
*** {Severity H}			
*** Physical Damage:**			
Observation:			
a. Abrasions.	EA		
*** {Severity L}			
b. Impact damage, dents.	EA		
*** {Severity M}			
*** Damaged Connections:**			
Observation:			
a. Fasteners that do not appear tight/snug.	EA		
*** {Severity M}			
b. Broken welds.	EA		
*** {Severity H}			
c. Missing fasteners.	EA		
*** {Severity H}			
*** Loss of Protective Coating/Paint:**			
Observation:			
a. Scraped/chipped paint.	SF		
*** {Severity L}			
b. Chalked paint.	SF		
*** {Severity L}			
c. Blistered paint.	SF		4
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.04 STEEL RISER PIPE

In a Tower Supported type tank, the Steel Riser Pipe is the central pipe that conveys the water to and from the tower. The riser pipe is typically a minimum of 36" in diameter to prevent freezing. An inspection manhole is usually located approximately 36" above grade level.

In a Pedestal type tank, constructed of steel or concrete, the Steel Riser Pipe is concealed within the shaft that supports the water storage shell. The riser pipe conveys water to and from the tank. To prevent freezing in cold climates or condensation in warm climates, the riser pipe is typically insulated.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Leakage:**			
Observation:			
a. Leakage at joints in riser pipe.	EA		
*** {Severity M}			
b. Leakage at other than Joints.	EA		
*** {Severity H}			
* **Corrosion:**			
Observation:			
a. Light surface corrosion (no pitting evident).	SF		
*** {Severity L}			
b. Moderate corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Severe corrosion evidenced by holes or loss of base metal.	SF		5
*** {Severity H}			
* **Physical Damage:**			
Observation:			
a. Abrasions.	EA		
*** {Severity L}			
b. Impact damage, dents.	EA		
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.04 STEEL RISER PIPE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged Connections:**			
Observation:			
a. Broken welds.	EA		
*** {Severity M}			
b. Fasteners that do not appear tight/snug.	EA		
*** {Severity M}			
c. Missing fasteners.	EA		
*** {Severity M}			
* **Loss of Protective Coating/Paint:**			
Observation:			
a. Scraped/chipped paint.	SF		
*** {Severity L}			
b. Chalked paint.	SF		
*** {Severity L}			
c. Blistered paint.	SF		6
*** {Severity M}			
* **Loss of Insulation:**			
Observation:			
a. Split insulation seams.	SF		
*** {Severity M}			
b. Damaged insulation.	SF		
*** {Severity M}			
c. Missing insulation.	SF		
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.05 STEEL TANK SHELL PLATES

The Steel Tank Shell Plates serve as the water containing vessel. The tank shell is typically fabricated from steel plates in varying thicknesses from 3/16 inch to greater than 2 inches. The plates are connected by welding or riveting.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage:**			
Observation:			
a. Leakage at joint.	EA		7
*** {Severity M}			
b. Leakage at other than joint.	EA		
*** {Severity H}			
*** Corrosion:**			
Observation:			
a. Light surface corrosion (no pitting evident).	SF		
*** {Severity M}			
b. Moderate corrosion evidenced by pitting or blistering.	SF		8
*** {Severity M}			
c. Buildup of mineral or other sediment inside tank.	SF		7
*** {Severity M}			
d. Severe corrosion evidenced by holes or loss of base metal.	SF		8
*** {Severity H}			
*** Physical Damage:**			
Observation:			
a. Abrasions.	EA		
*** {Severity L}			
b. Impact damage, dents.	EA		
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.05 STEEL TANK SHELL PLATES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged Connections:**			
Observation:			
a. Broken welds.	EA		
*** {Severity H}			
b. Fasteners that do not appear tight/snug	EA		
*** {Severity M}			
c. Missing fasteners.	EA		
*** {Severity H}			
* **Loss of Protective Coating/Paint:**			
Observation:			
a. Scraped/chipped paint.	SF		
*** {Severity L}			
b. Chalked paint.	SF		
*** {Severity L}			
c. Blistered paint.	SF		9
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

23.06.06 OVERFLOW PIPING/VENTS

The Overflow Piping serves to prevent the possible overfilling of the water storage tower. The Vents serve to prevent the pressurization or development of a vacuum within the water storage tower.

Overflows are typically constructed of a weir within the tank, connected to a pipe that extends to the exterior of the tank. The pipe either stubs below the tower balcony platform, or extends to approximately 1 to 2 feet above grade. The overflow pipe should be fitted with a flap valve or screen to prevent the ingress of birds and insects.

Vents are commonly welded to the tank roof. The vent should be fitted with a screen to prevent ingress of birds and insects.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Blockage:**			
Observation:			
a. Debris in overflow pipe.	EA		
*** {Severity L}			
b. Debris in vent.	EA		
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

23.06.07 CONCRETE TANKS AND PEDESTALS

Concrete pedestal tanks occur in several configurations, with single pedestal sphere or spheroid or modified pedestal. The tank portion of the structure serves to contain the stored water. The pedestal and shaft supports the tank and encloses the main riser and its associated control and operating components along with the overflow pipe. Internal communication is usually by a ladder of rungs cast into the pedestal shaft allowing access to the tank level of the structure. Tanks are vented and have access hatches for internal inspection and cleaning. Tank construction along with pedestal are usually monolithic pour type construction, although in some situations sections are precast and set in place. In all cases seals and allowances for expansion and contraction can provide areas susceptible to seepage and leaks.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Surface Weathering, Exterior Surfaces:**			
Observation:			
a. Weathered coating (paint), fine check cracking.	SF		
*** {Severity L}			
b. Staining, with chipping and spalling some seepage evident.	SF		10
*** {Severity M}			
c. Cracking greater than 1/8", spalling efflorescence, obvious leakage.	SF		11
*** {Severity H}			
*** Surface Deterioration, Interior Surfaces:**			
Observation:			
a. Minor spalling, chipping and cracking less than 1/16 inch wide.	SF		
*** {Severity L}			
b. Pronounced cracking up to 1/8 inch wide, with spalling and efflorescence.	SF		
*** {Severity M}			
c. Obvious concrete deterioration with exposed and corroded reinforcements.	SF		11
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

23.06.07 CONCRETE TANKS AND PEDESTALS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Expansion Joint Deterioration (Tank and Pedestal):**			
Observation:			
a. Joint material intact, no leaks separation less than 1/16 Inch.	SF		
*** {Severity L}			
b. Joint material loose, some seepage separation less than 1/8 Inch.	SF		
*** {Severity M}			
c. Joint material crumbly, loose and missing, obvious leaks.	SF		
*** {Severity H}			
*** Physical Damage (Tank and Pedestal):**			
Observation:			
a. Minor damage, chips, scars.	SF		
*** {Severity L}			
b. Impact damage, pieces of surface missing.	SF		
*** {Severity M}			
c. Substantial surface impact damage, deeper than 1", exposed reinforcement.	SF		
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

COMPONENTS (Continued)

◆ 23.06.08 ALTITUDE VALVES

The Altitude Valve serves to control the flow of water into and out of the tower. The valve is set to maintain a certain level within the tank. The valve is usually located at the base of the water tower system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Inoperative:**			
Observation:			
a. Device does not perform required function.	EA		1
*** {Severity M}			

23.06 ELEVATED WATER STORAGE TOWERS

◆ 23.06.09 CATHODIC PROTECTION SYSTEM

There are two types of cathodic protection systems, the galvanic anode system and the impressed current system. Either system can be used for protecting any one item from chemically-based, electrically-induced metal corrosion.

Items requiring cathodic protection are underground metal tanks, underwater metal piping, and above ground metal storage tanks containing an electrolyte.

Monitoring the performance of Cathodic Protection Systems requires both a Level I and Level III inspections. These will include the inspection records and condition observations listed below. The Level I inspections can trigger a Level III where shown. The interior of Elevated Water Storage Tanks are protected with cathodic protection so as to comply with the standards of NACE RP-O3-88 and IAW CEGS 16641.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Monitoring Records:**			
Observation:			
a. Historical data records less than 70% complete.	Set		12
*** {Severity H}			
b. Records missing or incomplete.	Set		12
*** {Severity H}			
c. Records indicate not on schedule performance.	Set		12
*** {Severity H}			
d. System not installed.	Set		12
*** {Severity H}			
e. System is inoperative.	Set		12
*** {Severity H}			

23.06 ELEVATED WATER STORAGE TOWERS

REFERENCES

1. ACU 224R, Control of Cracking in Concrete Structures
2. AWWA D101, Standard for Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage
3. AWWA D100, Standard for Welded Steel Tanks for Water Storage
4. NFPA 22, Water Tanks for Private Fire Protection
5. NAVFAC MOP-210.9, Dated August 1990

23.06 ELEVATED WATER STORAGE TOWERS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.06.08-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.06.02-1
2	GS-III 23.06.02-2
3	GS-III 23.06.03-3
4	GS-III 23.06.03-4
5	GS-III 23.06.04-5
6	GS-III 23.06.04-6
7	GS-III 23.06.05-7
8	GS-III 23.06.05-8
9	GS-III 23.06.05-9
10	GS-III 23.06.07-10
11	GS-III 23.06.07-11
12	GS-III 23.06.09-12

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ALTITUDE VALVE
CONTROL NUMBER: GS-II 23.06.08-1

Application

This guide applies to the investigation of possible malfunctions of the Altitude Valve.

Special Safety Requirements

No adjustments to the Altitude Valve shall be made by the inspector. Only authorized personnel shall exercise the valve.

Inspection Actions

1. Contact appropriate personnel to perform multiple level valve adjustments.
2. Ensure original valve settings are marked so valve may be returned to proper settings at conclusion of test.
3. Ensure overflow pipe is free of debris.
4. Observe actuation of the valve and resulting level control achieved to determine proper operation.
5. Ensure valve is reset to original settings at end of test.
6. Inspector to recommend repair as required.

Recommended Inspection Frequency

Every 2 Years

References

1. Operation and Maintenance Manual from the Manufacturer of the Valve being inspected

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: STRUCTURAL STEEL SUPPORTS
CONTROL NUMBER: GS-III 23.06.02-1

Application

This Guide Sheet applies to the investigation of the extent of damage done by observed corrosion defect/observations indicating a severity level involving loss of metal from the component being inspected.

Special Safety Requirements

No special safety requirements beyond those listed in the Master Safety Plan and the specific System , and Subsystem section are required. However referral to and compliance with these enumerated requirements are mandatory.

Inspection Actions

The services of a qualified Professional Structural Engineer are required to perform the following:

1. Review the existing drawings , if available, and the Level I inspection results that triggered this Level II inspection.
2. Evaluate the impact of the reported corrosion on the component inspected and its functioning that component.
3. Visit the site of the Elevated Water Storage Tower and view the corrosion, its location and severity and determine the impact on the Tower and its function.
4. Determine the extent of remedial work by type that needs to be done to correct the defect.
5. Prepare an estimate of the cost for the repairs recommended and required.

Special Tools and Equipment

1. Thorp Pipe Pit Gage, as Manufactured by W.R. Thorp and Company, Spavinaw, Oklahoma
2. Ultrasonic Metal Thickness Measurement device

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

References

1. AWWA D 101, Standard For Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks For Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: STRUCTURAL STEEL SUPPORTS
CONTROL NUMBER: GS-III 23.06.02-2

Application

This guide applies to the investigation of possible deterioration of the Coating/Paint system applied to interior and exterior surfaces. This inspection is appropriate when blistering of the Coating/Paint system is evident.

Special Safety Requirements

No special safety requirements are needed beyond those previously stipulated.

Inspection Actions

Perform an investigation to determine the extent of loss of adhesions of the Coating/Paint System.

1. Perform field adhesion testing using tensile testing instrument as prescribed in ASTM D-3359, Method D. If surface adhesion is less than the specified level, existing Coating/Painting system will have to be removed from affected area prior to recoating.
2. Utilize a Dry Film Thickness gauge to determine thickness of the Coating/Paint system. If thickness is greater than 12 mils, existing Coating/Painting system will have to be removed from affected areas prior to recoating.
3. Determine percentage of deteriorated Coating/Paint area with regard to the entire surface area. This will allow determination to be made on whether spot recoating application or total recoating will be required.
4. If removal of Coating/Paint system will be required based on above observations, obtain approximate 2" x 2", or as large as practical, sample of coating system in a plastic zipper lock bag for laboratory analysis so proper removal measures may be planned.

Special Tools and Equipment

1. Tensile Testing equipment
2. Dry Film Thickness Test equipment
3. Calculator
4. Plastic Zipper Lock Bag

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I defect/observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: STRUCTURAL STEEL SUPPORTS
CONTROL NUMBER: GS-III 23.06.02-2

References

1. ASTM D-3359, Measuring Surface Adhesion by Tape Method, Method D

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: STEEL LADDERS/PLATFORMS
CONTROL NUMBER: GS-III 23.06.03-3

Application

This Guide Sheet applies to the investigation of the extent of damage done by observed corrosion defect/observations indicating a severity level involving loss of metal from the component being inspected.

Special Safety Requirements

No special safety requirements beyond those listed in the Master Safety Plan and the specific System , and Subsystem section are required. However referral to and compliance with these enumerated requirements are mandatory.

Inspection Actions

The services of a qualified Professional Structural Engineer are required to perform the following:

1. Review the existing drawings, if available, and the Level I inspection results that triggered this Level II inspection.
2. Evaluate the impact of the reported corrosion on the component inspected and its functioning that component.
3. Visit the site of the Elevated Water Storage Tower and view the corrosion, its location and severity and determine the impact on the Tower and its function.
4. Determine the extent of remedial work by type that needs to be done to correct the defect.
5. Prepare an estimate of the cost for the repairs recommended and required.

Special Tools and Equipment

1. Thorp Pipe Pit Gage, as Manufactured by W.R. Thorp and Company, Spavinaw, Oklahoma
2. Ultrasonic Metal Thickness Measurement device

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

References

1. AWWA D 101, Standard For Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks For Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: STEEL LADDERS/PLATFORMS
CONTROL NUMBER: GS-III 23.06.03-4

Application

This guide applies to the investigation of possible deterioration of the Coating/Paint system applied to interior and exterior surfaces. This inspection is appropriate when blistering of the Coating/Paint system is evident.

Special Safety Requirements

No special safety requirements are needed beyond those previously stipulated.

Inspection Actions

Perform an investigation to determine the extent of loss of adhesions of the Coating/Paint System.

1. Perform field adhesion testing using tensile testing instrument as prescribed in ASTM D-3359, Method D. If surface adhesion is less than the specified level, existing Coating/Painting system will have to be removed from affected area prior to recoating.
2. Utilize a Dry Film Thickness gauge to determine thickness of the Coating/Paint system. If thickness is greater than 12 mils, existing Coating/Painting system will have to be removed from affected areas prior to recoating.
3. Determine percentage of deteriorated Coating/Paint area with regard to the entire surface area. This will allow determination to be made on whether spot recoating application or total recoating will be required.
4. If removal of Coating/Paint system will be required based on above observations, obtain approximate 2" x 2", or as large as practical, sample of coating system in a plastic zipper lock bag for laboratory analysis so proper removal measures may be planned.

Special Tools and Equipment

1. Tensile Testing equipment
2. Dry Film Thickness Test equipment
3. Calculator
4. Plastic Zipper Lock Bag

Recommended Inspection Frequency

This level III inspection should be performed when triggered by a Level I defect/observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: STEEL LADDERS/PLATFORMS
CONTROL NUMBER: GS-III 23.06.03-4

References

1. ASTM D-3359, Measuring Surface Adhesion by Tape Method, Method D

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: STEEL RISER PIPE
CONTROL NUMBER: GS-III 23.06.04-5

Application

This Guide Sheet applies to the investigation of the extent of damage done by observed corrosion defect/observations indicating a severity level involving loss of metal from the component being inspected.

Special Safety Requirements

No special safety requirements beyond those listed in the Master Safety Plan and the specific System , and Subsystem section are required. However referral to and compliance with these enumerated requirements are mandatory.

Inspection Actions

The services of a qualified Professional Structural Engineer are required to perform the following:

1. Review the existing drawings, if available, and the Level I inspection results that triggered this Level II inspection.
2. Evaluate the impact of the reported corrosion on the component inspected and its functioning that component.
3. Visit the site of the Elevated Water Storage Tower and view the corrosion, its location and severity and determine the impact on the Tower and its function.
4. Determine the extent of remedial work by type that needs to be done to correct the defect.
5. Prepare an estimate of the cost for the repairs recommended and required.

Special Tools and Equipment

1. Thorp Pipe Pit Gage, as Manufactured by W.R. Thorp and Company, Spavinaw, Oklahoma
2. Ultrasonic Metal Thickness Measurement device

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

References

1. AWWA D 101, Standard For Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks For Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: STEEL RISER PIPE
CONTROL NUMBER: GS-III 23.06.04-6

Application

This guide applies to the investigation of possible deterioration of the Coating/Paint system applied to interior and exterior surfaces. This inspection is appropriate when blistering of the Coating/Paint system is evident.

Special Safety Requirements

No special safety requirements are needed beyond those previously stipulated.

Inspection Actions

Perform an investigation to determine the extent of loss of adhesions of the Coating/Paint System.

1. Perform field adhesion testing using tensile testing instrument as prescribed in ASTM D-3359, Method D. If surface adhesion is less than the specified level, existing Coating/Painting system will have to be removed from affected area prior to recoating.
2. Utilize a Dry Film Thickness gauge to determine thickness of the Coating/Paint system. If thickness is greater than 12 mils, existing Coating/Painting system will have to be removed from affected areas prior to recoating.
3. Determine percentage of deteriorated Coating/Paint area with regard to the entire surface area. This will allow determination to be made on whether spot recoating application or total recoating will be required.
4. If removal of Coating/Paint system will be required based on above observations, obtain approximate 2" x 2", or as large as practical, sample of coating system in a plastic zipper lock bag for laboratory analysis so proper removal measures may be planned.

Special Tools and Equipment

1. Tensile Testing equipment
2. Dry Film Thickness Test equipment
3. Calculator
4. Plastic Zipper Lock Bag

Recommended Inspection Frequency

This level III inspection should be performed when triggered by a Level I defect/observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: STEEL RISER PIPE
CONTROL NUMBER: GS-III 23.06.04-6

References

1. ASTM D-3359, Measuring Surface Adhesion by Tape Method, Method D

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: STEEL TANK SHELL PLATES
CONTROL NUMBER: GS-III 23.06.05-7

Application

This guide applies to the investigation of possible deterioration of the steel Shell Plates that serve to contain the water. This inspection involves observation of the interior of the water storage tower.

Special Safety Requirements

Inspectors shall not enter the interior of a water storage tower if they have been under the care of a physician in the previous seven days. Inspectors shall only observe the interior of the water storage tower and shall not enter the water itself. Access shall be gained through the roof hatch on Tower supported type towers or through the manhole on Pedestal type towers. Inspectors shall conduct their work in a clean manner to preclude contamination of the water supply. Two persons are required to perform this task. Observe OSHA requirements for entry into confined spaces and the Master Safety Plan provision applicable to this activity along with all local requirements. In each case the most stringent requirements will be met.

Inspection Actions

1. Enter manhole or hatch to inspect the interior of the tank.
2. Observe location and extent of scale sediment build-up or corrosion on sides and bottom of the tank.
3. Observe the condition of the Coating/Paint system on the interior of the tank.
4. Exit the tank and close manholes or hatches as appropriate.
5. Recommend remedial action and provide cost estimate for same.

Special Tools and Equipment

None Required

Recommended Inspection Frequency

Every 5 years after installation or when "triggered" by a Level I defect/observation.

References

1. AWWA D101, Standard for Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: STEEL SHELL PLATES
CONTROL NUMBER: GS-III 23.06.05-8

Application

This Guide Sheet applies to the investigation of the extent of damage done by observed corrosion defect/observations indicating a severity level involving loss of metal from the component being inspected.

Special Safety Requirements

No special safety requirements beyond those listed in the Master Safety Plan and the specific System , and Subsystem section are required. However referral to and compliance with these enumerated requirements are mandatory.

Inspection Actions

The services of a qualified Professional Structural Engineer are required to perform the following:

1. Review the existing drawings, if available, and the Level I inspection results that triggered this Level II inspection.
2. Evaluate the impact of the reported corrosion on the component inspected and its functioning that component.
3. Visit the site of the Elevated Water Storage Tower and view the corrosion, its location and severity and determine the impact on the Tower and its function.
4. Determine the extent of remedial work by type that needs to be done to correct the defect.
5. Prepare an estimate of the cost for the repairs recommended and required.

Special Tools and Equipment

1. Thorp Pipe Pit Gage, as Manufactured by W.R. Thorp and Company, Spavinaw, Oklahoma
2. Ultrasonic Metal Thickness Measurement device

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

References

1. AWWA D 101, Standard For Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks For Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9

COMPONENT: STEEL TANK SHELL PLATES
CONTROL NUMBER: GS-III 23.06.05-9

Application

This guide applies to the investigation of possible deterioration of the Coating/Paint system applied to interior and exterior surfaces. This inspection is appropriate when blistering of the Coating/Paint system is evident.

Special Safety Requirements

No special safety requirements are needed beyond those previously stipulated.

Inspection Actions

Perform an investigation to determine the extent of loss of adhesions of the Coating/Paint System.

1. Perform field adhesion testing using tensile testing instrument as prescribed in ASTM D-3359, Method D. If surface adhesion is less than the specified level, existing Coating/Painting system will have to be removed from affected area prior to recoating.
2. Utilize a Dry Film Thickness gauge to determine thickness of the Coating/Paint system. If thickness is greater than 12 mils, existing Coating/Painting system will have to be removed from affected areas prior to recoating.
3. Determine percentage of deteriorated Coating/Paint area with regard to the entire surface area. This will allow determination to be made on whether spot recoating application or total recoating will be required.
4. If removal of Coating/Paint system will be required based on above observations, obtain approximate 2" x 2", or as large as practical, sample of coating system in a plastic zipper lock bag for laboratory analysis so proper removal measures may be planned.

Special Tools and Equipment

1. Tensile Testing equipment
2. Dry Film Thickness Test equipment
3. Calculator
4. Plastic Zipper Lock Bag

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9 (Continued)

COMPONENT: STEEL TANK SHELL PLATES
CONTROL NUMBER: GS-III 23.06.05-9

References

1. ASTM D-3359, Measuring Surface Adhesion by Tape Method, Method D

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10

COMPONENT: CONCRETE TANKS AND PEDESTALS
CONTROL NUMBER: GS-III 23.06.07-10

Application

This guide applies to the investigation of possible deterioration of the Coating/Paint system applied to interior and exterior surfaces. This inspection is appropriate when blistering of the Coating/Paint system is evident.

Special Safety Requirements

No special safety requirements are needed beyond those previously stipulated.

Inspection Actions

Perform an investigation to determine the extent of loss of adhesions of the Coating/Paint System.

1. Perform field adhesion testing using tensile testing instrument as prescribed in ASTM D-3359, Method D. If surface adhesion is less than the specified level, existing Coating/Painting system will have to be removed from affected area prior to recoating.
2. Utilize a Dry Film Thickness gauge to determine thickness of the Coating/Paint system. If thickness is greater than 12 mils, existing Coating/Painting system will have to be removed from affected areas prior to recoating.
3. Determine percentage of deteriorated Coating/Paint area with regard to the entire surface area. This will allow determination to be made on whether spot recoating application or total recoating will be required.
4. If removal of Coating/Paint system will be required based on above observations, obtain approximate 2" x 2", or as large as practical, sample of coating system in a plastic zipper lock bag for laboratory analysis so proper removal measures may be planned.

Special Tools and Equipment

1. Tensile Testing equipment
2. Dry Film Thickness Test equipment
3. Calculator
4. Plastic Zipper Lock Bag

Recommended Inspection Frequency

This level III Inspection should be performed when triggered by a Level I or II defect/observation.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10 (Continued)

COMPONENT: CONCRETE TANKS AND PEDESTALS
CONTROL NUMBER: GS-III 23.06.07-10

References

1. ASTM D-3359, Measuring Surface Adhesion by Tape Method, Method D

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: CONCRETE TANKS AND PEDESTALS
CONTROL NUMBER: GS-III 23.06.07-11

Application

This Guide Sheet applies to the investigation of the extent of damage done by observed concrete Cracking and deterioration defect/observations done at the Level I inspection indicating severe instances of the above described conditions.

Special Safety Requirements

No Special Safety Requirements Beyond those listed in the master safety plan and the specific system and subsystem sections are required. However referral to and compliance with the enumerated requirements are mandatory.

Inspection Actions

The services of a qualified Professional Structural Engineer are required to perform the following:

1. Review the Level I defect/observation that triggered this Level III inspection along with any available historical records concerning the component in question.
2. Go to the Elevated Water Storage Tower in question and examine the defect. Make an assessment of the importance of the individual defects observed as they effect the overall condition of the Concrete Tank, pedestal or base. Indicate priorities for the remedial efforts required, and a sequence for their performance.
3. Arrange with the Facility Manager for the performance inspection methods as recommended by the engineer among the following:

a. Crack Gages	degree of cracking and alignment of sections of tank
b. Electrical strain gages	cracking, and out-of alignment
c. Concrete coring	Degree of concrete deterioration
d. Laboratory tests on concrete cores	Strength test of concrete sample

Special Instructions

The coring of concrete to obtain test samples requires the draining of Concrete Tanks which must be coordinated in detail with the Facility Manager. Other agencies such as the Facility Fire Department, local water utility users etc. should be dealt with by the Facility Manager.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: CONCRETE TANKS AND PEDESTALS
CONTROL NUMBER: GS-III 23.06.07-11

Special Tolls and Equipment

The tools and equipment listed in the standard list along with the following are required:

Specific industry required equipment and devices needed to perform the listed advanced investigation tests and inspections chosen. Availability of Laboratory facilities qualified to perform the core sample testing required.

Recommended Inspection Frequency

As triggered by Level I and II defect/observations

Reference

1. AWWA D 101, Standard For Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks For Water Storage

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12

COMPONENT: CATHODIC PROTECTION SYSTEM
CONTROL NUMBER: GS-III 23.06.09-12

Application

This guide applies to the investigation of cathodic protection systems and their functioning as it relates to Elevated Water Storage Tanks and piping. Note that the criteria set forth in NACE RP-03-88 and IAW CEGS 16641 1110-3-440, "CATHODIC PROTECTION" require internal tank surfaces where an electrolyte is stored.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those required in the Master Safety Plan and in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Check for the presence of a cathodic protection system in the subject Elevated Water Storage Tank. This can be done by utilizing a measure of the structure-to-soil electrical potential with subsequent evaluation against the above cited criteria.
2. If a CP system is installed review the inspection records to verify the findings of the Level I inspection.
3. Check for the proper performance of the CP system per the requirements outlined above.
4. Review the results of the inspection with the Facility Manager along with any further investigation recommended and/or the corrective actions indicated to be necessary.
5. Provide the Facility Manager with a complete report of findings, corrective measure and a projected cost for the actions necessary to repair the CP system or Tank, and any requirements to bring the installation into compliance with the referenced standards
6. Note nothing in the above procedure relives the Facility Manager of his responsibility to perform periodic testing etc. as required by Law, Code or other legal entities. Specifically this inspection will not substitute for, or be construed as meeting those legal requirements.

Special Tools and Equipment

No special tools are needed for the performance of this Level III inspection beyond the requirements listed in the Standard Tools Section.

Recommended Inspection Frequency

Do this Level III inspection when triggered by a Level I inspection.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12 (Continued)

COMPONENT: CATHODIC PROTECTION SYSTEM
CONTROL NUMBER: GS-III 23.06.09-12

References

1. NAVFAC NO-306, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280k
   Part 192,
   Part 1955,

3. U. S. Army regulation, AR 200-1

4. National Association of Corrosion Engineers (NACE) Standards:
   RP-03-88, (IMPRESSED CURRENT CATHODIC PROTECTION OF INTERNAL SUBMERGED SURFACES OF STEEL WATER TANKS.)

   RP-01-69,92 (CONTROL OF EXTERNAL CORROSION ON UNDERGROUND OR SUBMERGED METALLIC PIPING SYSTEMS.)

5. Materials Performance Magazine, September 1992, Computer Monitoring of Cathodic Protection Systems for Underground Structures, by Vicki Van Blaircum and Ashok Kumar.

6. ETL 1110-9-10 (FR), (CATHODIC PROTECTION SYSTEM USING CERAMIC ANODES.)

23.07 STEAM DISTRIBUTION SYSTEMS

DESCRIPTION

The Steam Distribution System is a subsystem of the Infrastructure System. The steam distribution system distributes steam from the central heating plant to designated building steam distribution systems. The system is normally installed above ground, it may also run underground in a concrete tunnel or tiled conduit.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Steam Distribution Systems:

1. Pry bar
2. Scraper
3. Wire brush
4. Calipers
5. Measuring scales
6. Hammer
7. Ice pick or pocket knife
8. 1/2" Drive Socket Set
9. Infrared thermometer

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Steam Distribution Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- 23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
- 23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
- 23.07.03 MANHOLES

23.07 STEAM DISTRIBUTION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
23.08	STEAM CONDENSATE RETURN SYSTEMS
28.02	STEAM DISTRIBUTION SYSTEMS
28.03	STEAM CONDENSATE RETURN SYSTEMS

23.07 STEAM DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Steam Distribution System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND

Piping and fittings provide the distribution network for the steam system that is visible above ground level. Valves are installed to control the steam supply and isolate system parts. Steam traps are devices for removing condensate from the steam heating system. Steam traps are normally located at low points in the piping system. If the trap is inaccessible for the Level I inspection the inspector may choose a Level III inspection method.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Steam leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Steam leaking.	LF		
*** {Severity H}			
*** Plugged strainer.**			
Observation:			
a. Temperature difference between inlet and outlet of strainer.	EA	1	
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged/defective strainer.**			
Observation:			
a. Cracked strainer, not leaking.	EA		
*** {Severity M}			
b. Cracked strainer, steam leaking.	EA		
*** {Severity H}			
*** Loose/missing support/hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity H}			
*** Defective valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
e. Inoperable valve.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective guides or anchors.**			
Observation:			
a. Loose guides or anchors.	EA		
*** {Severity L}			
b. Broken or missing guides or anchors.	EA		
*** {Severity H}			
*** Defective support poles - wood.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Split, rot or parasite deteriorated cross section support members.	EA	2	1
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective support poles - concrete.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Cracking, scaling or spalling deteriorated cross section support members.	EA		2
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective support poles - metal.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Cracking, buckling or stress deformation of support members.	EA		3
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
*** Corroded valves/stainers/traps.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded hangers/supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Steam loss at trap.**			
Observation:			
a. Trap blows live steam.	EA		5
*** {Severity H}			
b. Broken/damaged steam trap.	EA		5
*** {Severity H}			
*** Trap continuously discharging condensate.**			
Observation:			
a. Trap is not sized correctly .	EA		
*** {Severity M}			
b. Damaged/defective trap.	EA		5
*** {Severity H}			
*** Cold trap - no discharge.**			
Observation:			
a. No condensate/steam coming to trap.	EA		6
*** {Severity M}			
b. Pipe line/fittings plugged.	EA		6
*** {Severity M}			
c. Strainer plugged.	EA		6
*** {Severity M}			
d. Broken/damaged steam trap.	EA		5
*** {Severity H}			
e. Broken valve in line to trap.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.01 PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot trap - no discharge.**			
Observation:			
a. No condensate coming to trap.	EA		
*** {Severity M}			
b. Improper installation, trap installed above leaking by-pass valve.	EA		
*** {Severity M}			
c. Broken/damaged steam trap.	EA		5
*** {Severity H}			
d. Noisy high pitch sound.	EA		
*** {Severity H}			
*** Defective pipe labeling.**			
Observation:			
a. Damaged/missing labels.	EA		
*** {Severity L}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND

Piping and fittings provides the network for the steam distribution system. The underground network consist of following types:

Conduit systems are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems are designed to permit drainage of the conduit in place and to permit drying of the insulation if the system is flooded.

Tile conduit and concrete trenches are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems have rigid pipe supports, insulation, air space and sloped bases for complete drainage.

Walking tunnels are similar to concrete trenches except that they are sufficiently large to permit personnel walking through it for inspection or repairs.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Steam leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Steam leaking.	LF		
*** {Severity H}			
*** Plugged strainer.**			
Observation:			
a. Temperature difference between inlet and outlet of strainer.	EA	3	
*** {Severity H}			
*** Damaged/defective strainer.**			
Observation:			
a. Cracked strainer, not leaking.	EA		
*** {Severity M}			
b. Cracked strainer, steam leaking.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Loose/missing supports/hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Deteriorated sacrificial anodes.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent.	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF	4	
*** {Severity H}			
*** Defective valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
e. Inoperable valve.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
*** Corroded valves/strainers/traps.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Steam loss at trap.**			
Observation:			
a. Trap blows live steam.	EA		7
*** {Severity H}			
b. Broken/damaged steam trap.	EA		7
*** {Severity H}			
*** Trap continuously discharging condensate.**			
Observation:			
a. Trap is not sized correctly.	EA		
*** {Severity M}			
b. Damaged/defective trap.	EA		7
*** {Severity H}			
*** Cold trap - no discharge.**			
Observation:			
a. No condensate/steam coming to trap.	EA		8
*** {Severity M}			
b. Pipe line/fittings plugged.	EA		8
*** {Severity M}			
c. Strainer plugged.	EA		8
*** {Severity M}			
d. Broken/damaged steam trap.	EA		
*** {Severity H}			
e. Broken valve in line to trap.	EA		7
*** {Severity H}			
*** Hot trap - no discharge.**			
Observation:			
a. No condensate coming to trap.	EA		
*** {Severity M}			
b. Improper installation, trap installed above leaking by-pass valve.	EA		
*** {Severity M}			
c. Broken/damaged steam trap.	EA		7
*** {Severity H}			
d. Noisy high pitch sound.	EA		
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.07.02 PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Missing or expired letter of accreditation-underground distribution systems.**			
Observation:			
a. Missing or expired letter of accreditation by official agency.	EA		
*** {Severity S}			
*** Defective pipe labeling.**			
Observation:			
a. Damaged/missing labels.	EA		
*** {Severity L}			
*** Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log.	EA		11
*** {Severity M}			
b. Disconnected or missing DC or AC power source.	EA		11
*** {Severity H}			
c. Zero reading on the meter.	EA		11
*** {Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.03 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective Manhole cover or ladder.**			
Observation:			
a. Bent/damaged frame/manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing manhole cover.	EA		
*** {Severity H}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			
*** Defective drainage.**			
Observation:			
a. Debris in manholes.	EA		
*** {Severity M}			
b. Malfunctioning gravity drain.	EA		
*** {Severity M}			
c. Inoperable or missing float controls.	EA		
*** {Severity H}			
d. Inoperable or missing sump pump.	EA		
*** {Severity H}			
e. Surcharged manhole.	EA		
*** {Severity H}			
*** Defective Conduit/end caps.**			
Observation:			
a. Defective welds at conduit end cap.	LF		
*** {Severity M}			
b. Missing conduit vent pipe.	LF		
*** {Severity M}			
c. Missing conduit drain plug.	EA		
*** (Severity H}			

23.07 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.07.03 MANHOLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
*** Corrosion of steel wall/bottom/roof.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective manhole ventilation.**			
Observation:			
a. Damaged vent pipe.	LF		
*** {Severity L}			
b. Missing vent pipe.	LF		
*** {Severity H}			
c. Clogged vent holes.	EA		
*** {Severity F}			

23.07 STEAM DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

2. NAVFAC MO-306, Cathodic Protection Systems Maintenance, 1992

3. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

4. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air

5. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc., 6th Edition

6. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

7. Means Facility Cost Data, Phillip R. Waier, PE, 1993

8. USACERL TR M-91/01, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

23.07 STEAM DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.07.01-1
2	GS-II 23.07.01-2
3	GS-II 23.07.02-3
4	GS-II 23.07.02-4

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.07.01-1
2	GS-III 23.07.01-2
3	GS-III 23.07.01-3
4*	GS-III 23.07.01-4*
5	GS-III 23.07.01-5
6	GS-III 23.07.01-6
7	GS-III 23.07.02-7
8	GS-III 23.07.02-8
9*	GS-III 23.07.02-9*
10*	GS-III 23.07.02-10*
11	GS-III 23.07.02-11

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-II 23.07.01-1

Application

This guide applies to the detection of a plugged strainer using an infrared thermometer method of testing. This method should be used when the strainer is in an inaccessible location.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Aim the infrared thermometer at the inlet and outlet of the strainer and record the temperature differential.
2. If temperature difference is 50 degrees F or greater, then it can be assumed that the strainer is not operating properly.

Recommended Inspection Frequency

Annually

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition

3. The Hartford Steam Boiler Inspection and Insurance Company

4. NAVFAC MO-209, Maintenance of Steam, Hot Water & Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-II 23.07.01-2

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings, valves and steam traps due to insect infestation, rot, or fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-II 23.07.02-3

Application

This guide applies to the detection of a plugged strainer using an infrared thermometer method of testing.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Acquire confined space entry permit from base safety officer.
2. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Aim the infrared thermometer at the inlet and outlet of the strainer and record the temperature differential.
2. If temperature difference is 50 degrees F or greater, then it can be assumed that the strainer is not operating properly.

Recommended Inspection Frequency

Annually

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993
2. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
3. The Hartford Steam Boiler Inspection and Insurance Company
4. NAVFAC MO-209, Maintenance of Steam, Hot Water & Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-II 23.07.02-4

Application

This guide applies to the investigation of the integrity of the insulation on the underground piping system.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and system Safety Section.

1. Acquire confined space entry permit from base safety officer.
2. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Observe area above and along route of underground piping to determine if high heat loss is evident by such observations as burnt grass or in winter by rapid snow/ice melting.
2. Remove drain plug from end of conduit end plates in the manholes and drain conduit to determine if amount of water accumulated in the air space between the insulated heat carrying pipe and the conduit could have effected the integrity of the pipe insulation.
3. Reinstall drain plug.
4. Remove a sampling of removable protective jacket on the pipe insulation in the manholes to determine condition of the insulation.
5. Reinstall protective jacket on the pipe insulation.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. USECERL, TR M-91/01, March 1991 Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-1

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings, valves and steam traps due to insect infestation, rot and fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Sound with hammer.
2. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
3. Test with a moisture meter.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-2

Application

This guide applies to the investigation of cracks in concrete support poles of piping, fittings, valves and steam traps.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-3

Application

This guide applies to the investigation of cracked welds in metal support poles of piping, fittings, valves and steam traps.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.
4. Perform NDT, in this case high frequency ultrasonic inspection of the cracks to determine extent of subsurface damage.
5. Check any other suspect areas such as patches and repairs.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire brush
2. Dye penetrant and developer
3. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1 Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-4*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings are defective or damaged.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facilities Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-5

Application

This guide applies to the investigation of the proper operation of a steam trap using a audio amplifier. Considerable experience is required for this method of testing as other noises are telegraphed along the pipe lines. When several traps are close together in the piping system, ultrasonic testers, responding only to frequencies above 35 kilohertz, are useful.

Special Safety Requirements

No special safety requirements ar needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe steam trap operation:
2. Listen for the trap to discharge:
3. Thermostatic traps: When properly sized for the load, will discharge intermittently. Therefore, if the trap is operating properly, a loud hissing sound will be heard during discharge; no sound will be heard when trap is closed. If hissing sound continues after, the trap is leaking.
4. Bucket traps: Will operate intermittently. When the trap is working properly, a hissing noise will be heard during discharge, and when the trap closes, the sound stops.
5. Thermodynamic traps: This type of trap will open and close frequently depending on the trap load and the mechanical condition of the trap. Generally, if the trap cycles fewer than 10 times per minute, it is operating normally.
6. Impulse traps: A bleed hole is drilled through the piston allowing flow from inlet to outlet even when the trap is closed. Therefore, with the trap closed, a hissing sound will be heard. If a loud noise is heard continuously, the trap is either overloaded or stuck in the open position.
7. Float-thermostatic traps: These traps have a tendency to discharge continuously, particularly at low or moderate pressures, and modulate according to the load ahead of the trap. Under these conditions, ultrasonic testers are of no value. However, when float-thermostatic traps are used at high pressures, they tend to discharge intermittently, if the tester indicates a rhythmic intermittent discharge, the trap is working properly.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-5

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Audio amplifier

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water & Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - ABOVE GROUND
CONTROL NUMBER: GS-III 23.07.01-6

Application

This guide applies to the detection of a defective steam trap using an infrared thermometer method of testing. This method should be used when the trap is in an inaccessible location.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Take temperature measurements immediately adjacent, no more than 2 feet, on either side of trap.
2. If the temperature difference is less than 30 degrees F, than it can be assumed that the trap is operating properly.

Special Tools And Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared thermometer

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. II Inspection of Shore Facilities 1993
2. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-7

Application

This guide applies to the investigation of the proper operation of a steam trap using a audio amplifier. Considerable experience is required for this method of testing as other noises are telegraphed along the pipe lines. When several traps are close together in the piping system, ultrasonic testers, responding only to frequencies above 35 kilohertz, are useful.

Special Safety Requirements

The following is a list of special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section.

1. Acquire confined space entry permit from base safety officer.
2. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Observe steam trap operation:
2. Listen for the trap to discharge:
3. Thermostatic traps: When properly sized for the load, will discharge intermittently. Therefore, if the trap is operating properly, a loud hissing sound will be heard during discharge; no sound will be heard when trap is closed. If hissing sound continues after, the trap is leaking.
4. Bucket traps: Will operate intermittently. When the trap is working properly, a hissing noise will be heard during discharge, and when the trap closes, the sound stops.
5. Thermodynamic traps: This type of trap will open and close frequently depending on the trap load and the mechanical condition of the trap. Generally, if the trap cycles fewer than 10 times per minute, it is operating normally.
6. Impulse traps: A bleed hole is drilled through the piston allowing flow from inlet to outlet even when the trap is closed. Therefore, with the trap closed, a hissing sound will be heard. If a loud noise is heard continuously, the trap is either overloaded or stuck in the open position.
7. Float-thermostatic traps: These traps have a tendency to discharge continuously, particularly at low or moderate pressures, and modulate according to the load ahead of the trap. Under these conditions, ultrasonic testers are of no value. However, when float-thermostatic traps are used at high pressures, they tend to discharge intermittently, if the tester indicates a rhythmic intermittent discharge, the trap is working properly.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7 (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-7

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section:

1. Audio amplifier.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water & Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-8

Application

This guide applies to the detection of a defective steam trap using an infrared thermometer method of testing. This method should be used when the trap is in an inaccessible location.

Special Safety Requirements

The following is a list of special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section.

1. Acquire confined space entry permit from base safety officer.
2. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Take temperature measurements immediately adjacent, no more than 2 feet, on either side of trap.
2. If the temperature difference is less than 30 degrees F, than it can be assumed that the trap is operating properly.

Special Tools And Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared thermometer

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8 (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-8

References

1. NAVFAC MO-322 Vol. II Inspection of Shore Facilities 1993
2. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-9*

Application

This guide applies for the use of ultrasonic testing equipment to investigate the interior of piping for leaks, cracks and separations. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section.

1. Acquire confined space entry permit from base safety officer.
2. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Isolate the pipe section.
2. Perform the ultrasonic test on pipe section.
3. Document the readings and compare to wall thickness of piping in ASTM manual to determine of piping is defective or damaged.
4. Return pipe to service.

Special Tools and Equipment

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the underground pipe:

1. Ultrasonic testing equipment.
2. Test vehicle (Smart Pig).

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

LEVEL III GUIDE SHEET - KEY NO. 9* (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-9*

References

LEVEL III INSPECTION METHOD GUIDE SHEET

1. NAVFAC MO-322 Vol II Inspection of Shore Facilities, 1993

2. Nondestructive Testing of Water Mains for Physical Integrity. American Water Works Association. ISBN 0-89867-620-7. 1992

3. Water Audits and Leak Detection, Manual of Water Supply Practices, American Water Works Association, AWWA M36, 1990

4. Tri-State Utilities, Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10*

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-10*

Application

This guide applies to the use of compressed air to test the casing integrity of the pressure testable conduit system. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This procedure is not applicable for tile conduit systems, corrugated conduit systems or any concrete trench systems.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to perform the test.
2. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Check to be sure conduit end plates properly seal the conduit.
2. Pressurize the air space in the conduit to 15 PSI using the drain plug or vent pipe opening in the end plate as a connection for the air compressor hose.
3. Cut off compressor.
4. Record readings of the air pressure inside the conduit every ten minutes for a minimum of one hour.
5. Reinstall the drain plug and or vent pipe in the end plate as necessary.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Portable air compressor and hose
2. Pressure gauge

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the conduit system. If there is no manufacturer's recommendation an inspection should be performed on a three year cycle or whenever the desired degree of reliability justifies the procedure.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10* (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-10*

References

1. USACERL TR M-91/01, March 1991, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

3. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-11

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11 (Continued)

COMPONENT: PIPING, FITTINGS, VALVES AND STEAM TRAPS - UNDERGROUND
CONTROL NUMBER: GS-III 23.07.02-11

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

23.08 STEAM CONDENSATE RETURN SYSTEMS

DESCRIPTION

The Steam Condensate Return System is a subsystem of the Infrastructure System. The steam condensate return system collects steam condensate and returns the water to the central heating plant.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Steam Condensate Return Systems:

1. 1/2" Drive socket set
2. Pry bar
3. Scraper
4. Wire brush
5. Calipers
6. Measuring scales
7. Hammer
8. Ice pick or pocket knife

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Steam Condensate Return Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.08.01 PIPING, FITTINGS AND VALVES - ABOVE GROUND
- ◆ 23.08.02 PIPING, FITTINGS AND VALVES - UNDERGROUND
- ◆ 23.08.03 MANHOLES

23.08 STEAM CONDENSATE RETURN SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

08.18	STEAM CONDENSATE RETURN SYSTEMS
28.03	STEAM CONDENSATE RETURN SYSTEMS

23.08 STEAM CONDENSATE RETURN SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Steam Condensate Return System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.08.01 PIPING, FITTINGS AND VALVES - ABOVE GROUND

Piping, fittings and valves provide the collection and discharge network for the steam condensate return system that is visible above ground level.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.01 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective guides or anchors.**			
Observation:			
a. Loose guides or anchors.	EA		
*** {Severity L}			
b. Broken or missing guides or anchors.	EA		
*** {Severity H}			
*** Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective support poles - wood.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8'.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8'.	EA		
*** {Severity H}			
d. Split, rot or parasite deteriorated cross section support members.	EA	1	1
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.01 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective support poles - concrete.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Cracking, scaling or spalling deteriorated cross section support members.	EA		2
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective support poles - metal.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Cracking, buckling or stress deformation of support members.	EA		3
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.01 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping and fittings**			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Defective pipe labeling.**			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity L}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.02 PIPING, FITTINGS AND VALVES - UNDERGROUND

Piping and fittings provides the network for the steam condensate return system. The underground network consist of following types:

Conduit systems are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems are designed to permit drainage of the conduit in place and to permit drying of the insulation if the system is flooded.

Tile conduit and concrete trenches are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems have rigid pipe supports, insulation, air space and sloped bases for complete drainage.

Walking tunnels are similar to concrete trenches except that they are sufficiently large to permit personnel walking through it for inspection or repairs.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.02 PIPING, FITTINGS AND VALVES - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective galvanic anode cathodic protection systems.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent.	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF	2	
*** {Severity M}			
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ **23.08.02 PIPING, FITTINGS AND VALVES - UNDERGROUND (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log.	EA		5
*** {Severity M}			
b. Disconnected or missing DC or AC power source.	EA		5
*** {Severity H}			
c. Zero reading on the meter.	EA		5
*** {Severity H}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.03 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective Manhole cover or ladder.**			
Observation:			
a. Bent/damaged frame/manhole cover. *** {Severity M}	EA		
b. Damaged/broken ladder rungs. *** {Severity H}	EA		
c. Missing rungs. *** {Severity H}	EA		
d. Missing manhole cover. *** {Severity H}	EA		
e. Manhole entrance/frame is offset. *** {Severity H}	EA		
*** Defective drainage.**			
Observation:			
a. Debris in manholes. *** {Severity M}	EA		
b. Malfunctioning gravity drain. *** {Severity M}	EA		
c. Inoperable or missing float controls. *** {Severity H}	EA		
d. Inoperable or missing sump pump. *** {Severity H}	EA		
e. Surcharged manhole. *** {Severity H}	EA		
*** Defective Conduit/end caps.**			
Observation:			
a. Defective welds at conduit end cap. *** {Severity M}	LF		
b. Missing conduit vent pipe. *** {Severity M}	LF		
c. Missing conduit drain plug. *** (Severity H}	EA		

23.08 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 23.08.03 MANHOLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
*** Corrosion of steel wall/bottom/roof.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective manhole ventilation.**			
Observation:			
a. Damaged vent pipe.	LF		
*** {Severity L}			
b. Missing vent pipe.	LF		
*** {Severity H}			
c. Clogged vent holes.	EA		
*** {Severity F}			

23.08 STEAM CONDENSATE RETURN SYSTEMS

REFERENCES

1. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

2. NAVFAC MO-306, Cathodic Protection Systems Maintenance, 1992

3. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

4. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air

5. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc., 6th Edition

6. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

7. USACERL TR M-91/01, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

23.08 STEAM CONDENSATE RETURN SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.08.01-1
2	GS-II 23.08.02-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.08.01-1
2	GS-III 23.08.01-2
3	GS-III 23.08.01-3
4*	GS-III 23.08.02-4*
5	GS-III 23.08.02-5

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-II 23.08.01-1

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings and valves due to insect infestation, rot or fungi damage..

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-II 23.08.02-2

Application

This guide applies to the investigation of the integrity of the insulation on the underground piping system.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and system Safety Section.

1. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Observe area above and along route of underground piping to determine if high heat loss is evident by such observations as burnt grass or in winter by rapid snow/ice melting.
2. Remove drain plug from end of conduit end plates in the manholes and drain conduit to determine if amount of water accumulated in the air space between the insulated heat carrying pipe and the conduit could have effected the integrity of the pipe insulation.
3. Reinstall drain plug.
4. Remove a sampling of removable protective jacket on the pipe insulation in the manholes to determine condition of the insulation.
5. Reinstall protective jacket on the pipe insulation.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. USECERL, TR M-91/01, March 1991 Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.08.01-1

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings, and valves due to insect infestation, rot or fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Sound with hammer.
2. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
3. Test with a moisture meter.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.08.01-2

Application

This guide applies to the investigation of cracks in concrete support poles of above ground piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.08.01-3

Application

This guide applies to the investigation of cracks and cracked welds in metal support poles.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.
4. Perform NDT, in this case high frequency ultrasonic inspection of the cracks to determine extent of subsurface damage.
5. Check any other suspect areas such as patches and repairs.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire brush
2. Dye penetrant and developer
3. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. MEANS Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.08.02-4*

Application

This guide applies to the use of compressed air to test the casing integrity of the pressure testable conduit system. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This procedure is not applicable for tile conduit systems, corrugated conduit systems or any concrete trench systems.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to perform the test.
2. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Check to be sure conduit end plates properly seal the conduit.
2. Pressurize the air space in the conduit to 15 PSI using the drain plug or vent pipe opening in the end plate as a connection for the air compressor hose.
3. Cut off compressor.
4. Record readings of the air pressure inside the conduit every ten minutes for a minimum of one hour.
5. Reinstall the drain plug and or vent pipe in the end plate as necessary.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Portable air compressor and hose
2. Pressure gauge

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the conduit system. If there is no manufacturer's recommendation an inspection should be performed on a three year cycle or whenever the desired degree of reliability justifies the procedure.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. *4 (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.08.02-4*

References

1. USACERL TR M-91/01, March 1991, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

3. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.08.02-5

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.08.02-5

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

DESCRIPTION

The Heating Hot Water Distribution System is a subsystem of the Infrastructure System. The heating hot water distribution system circulates hot water from the central heating plant to designated building heating hot water systems and back.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are needed to perform the inspection of Heating Hot Water Distribution Systems:

1. Scraper
2. Wire brush
3. Calipers
4. Measuring scales
5. Hammer
6. Ice pick or pocket knife
7. 1/2" Drive socket set
8. Pry bar

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Heating Hot Water Distribution Systems.

If the inspector needs to physically enter a manhole:

a. Notify Safety and Facility Engineering personnel and obtain the required authorization.
b. Extreme caution must be exercised.
c. Only personnel trained in confined space entry safety procedures are permitted to enter the manhole.
d. A trained standby person with communication to all workers within the confined space entry is required.

COMPONENT LIST

- ◆ 23.09.01 PUMP BASES AND COUPLINGS
- ◆ 23.09.02 PUMPS
- ◆ 23.09.03 MOTORS
- ◆ 23.09.04 CONTROLS
- ◆ 23.09.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND
- ◆ 23.09.06 PIPING, FITTINGS AND VALVES - UNDERGROUND
- ◆ 23.09.07 MANHOLES
- ◆ 23.09.08 VALVEBOX - CONCRETE
- ◆ 23.09.09 VALVEBOX - BRICK, CMU OR STONE
- ◆ 23.09.10 VALVEBOX - STEEL

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS
17.01	TUNNEL STRUCTURE
17.02	TUNNEL DRAINAGE
28.04	HEATING HOT WATER DISTRIBUTION SYSTEMS

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Heating Hot Water Distribution System will be scheduled when the equipment is in operation and environmental conditions permit.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 23.09.01 PUMP BASES AND COUPLINGS

The pump base is the mounting platform for the pump and motor, the coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting bolts.**			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.01 PUMP BASES AND COUPLINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
* **Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump assembly, abandoned.	EA		
*** {Severity L}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.02 PUMPS

Pumps provide for hot water circulation throughout the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking at pump fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration at pump.**			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.02 PUMPS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.03 MOTORS

Electric motors are used to drive the circulating pumps. In-line circulating pumps ar typically driven via spring-coupled motors, pedestal-mounted pumps are typically driven via rigid or flex-coupled motors.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.04 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective control panel.**			
Observation:			
a. Physically damaged control panel enclosure.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND

Piping and fittings provide the distribution network for the heating hot water distribution system that is visible above ground. Valves are installed to control the heating hot water supply, isolate system parts and provide a means for drainage.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fitting.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
*** Defective guides or anchors.**			
Observation:			
a. Loose guides or anchors.	EA		
*** {Severity L}			
b. Broken or missing guides or anchors.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
*** Defective support poles - wood.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Split, rot or parasite deteriorated cross section support members.	EA	3	6
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective support poles - concrete.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8′.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8′.	EA		
*** {Severity H}			
d. Cracking, scaling or spalling deteriorated cross section support members.	EA		7
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective support poles - metal.**			
Observation:			
a. Loose support members.	EA		
*** {Severity L}			
b. Out of plumb, less than or equal to 3" in 8'.	EA		
*** {Severity M}			
c. Out of plumb, greater than 3" in 8'.	EA		
*** {Severity H}			
d. Cracking, buckling or stress deformation of support members.	EA		8
*** {Severity H}			
e. Broken or missing support poles.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity M}			
*** Corroded piping and fittings.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.05 PIPING, FITTINGS AND VALVES - ABOVE GROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.06 PIPING, FITTINGS AND VALVES - UNDERGROUND

Piping and fittings provides the network for the heating hot water distribution system. The underground network consist of following types:

Conduit systems are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems are designed to permit drainage of the conduit in place and to permit drying of the insulation if the system is flooded.

Tile conduit and concrete trenches are single or multiple pipe systems that are totally enclosed in a waterproof structure. The systems have rigid pipe supports, insulation, air space and sloped bases for complete drainage.

Walking tunnels are similar to concrete trenches except that they are sufficiently large to permit personnel walking through it for inspection or repairs.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Defective valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.06 PIPING, FITTINGS AND VALVES - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
* **Defective galvanic anode cathodic protection systems.**			
Observation:			
a. Percent thickness loss, 50 to 80 percent	EA		
*** {Severity M}			
b. Percent thickness loss, greater than 80 percent.	EA		
*** {Severity H}			
c. Loose fasteners or broken welds.	EA		
*** {Severity H}			
* **Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged/missing insulation.	SF		14
*** {Severity H}			
* **Corroded piping and fittings.**			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.06 PIPING, FITTINGS AND VALVES - UNDERGROUND (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded valves.**			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Corroded hangers or supports.**			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
*** Defective impressed current cathodic protection systems.**			
Observation:			
a. Variations or changes in the readings recorded in the log.	EA		15
*** {Severity M}			
b. Disconnected or missing DC or AC power source.	EA		15
*** {Severity H}			
c. Zero reading on the meter.	EA		15
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

♦ 23.09.07 MANHOLES

Manholes are inspection and maintenance accesses that are positioned at critical connection points in the distribution system. The larger manholes are reinforced concrete construction where as smaller ones may be constructed of prefabricated steel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective Manhole cover or ladder.**			
Observation:			
a. Bent/damaged frame/manhole cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing manhole cover.	EA		
*** {Severity H}			
e. Manhole entrance/frame is offset.	EA		
*** {Severity H}			
*** Defective drainage.**			
Observation:			
a. Debris in manholes.	EA		
*** {Severity M}			
b. Malfunctioning gravity drain.	EA		
*** {Severity M}			
c. Inoperable or missing float controls.	EA		
*** {Severity H}			
d. Inoperable or missing sump pump.	EA		
*** {Severity H}			
e. Surcharged manhole.	EA		
*** {Severity H}			
*** Defective Conduit/end caps.**			
Observation:			
a. Defective welds at conduit end cap.	LF		
*** {Severity M}			
b. Missing conduit vent pipe.	LF		
*** {Severity M}			
c. Missing conduit drain plug.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.07 MANHOLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Deteriorated wall/bottom/roof.**			
Observation:			
a. Cracks, spalling.	SF		
*** {Severity M}			
b. Exposed reinforcing.	SF		
*** {Severity H}			
* **Corrosion of steel wall/bottom/roof.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
* **Defective manhole ventilation.**			
Observation:			
a. Damaged vent pipe.	LF		
*** {Severity L}			
b. Missing vent pipe.	LF		
*** {Severity H}			
c. Clogged vent holes.	EA		
*** {Severity F}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.08 VALVE BOX - CONCRETE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or spalling of concrete walls.**			
Observation:			
a. Wide cracks, between 1/16" and 1/4" wide.	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.09.08 VALVE BOX - CONCRETE Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2′ of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharge valvebox.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.09 VALVE BOX - BRICK, CMU OR STONE

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged brick, CMU or stone walls.**			
Observation:			
a. Cracked, split or damaged.	SF		
*** {Severity M}			
b. Loose or missing brick or stone.	SF		
*** {Severity H}			
*** Deteriorated mortar joint material.**			
Observation:			
a. Loose mortar joint material.	SF		
*** {Severity M}			
b. Missing mortar joint material.	SF		
*** {Severity H}			
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4′.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4′.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **23.09.09 VALVE BOX - BRICK, CMU OR STONE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Valvebox full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 23.09.10 VALVE BOX - STEEL

A covered box either with open-jointed lining or filled with coarse aggregate through which access is gained to underground valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Out of plumb box wall.**			
Observation:			
a. Less than or equal to 1 1/2" in 4'.	SF		
*** {Severity M}			
b. Greater than 1 1/2" in 4'.	SF		
*** {Severity H}			
*** Corrosion of steel box.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective valvebox cover or ladder.**			
Observation:			
a. Bent/damaged frame/cover.	EA		
*** {Severity M}			
b. Damaged/broken ladder rungs.	EA		
*** {Severity H}			
c. Missing rungs.	EA		
*** {Severity H}			
d. Missing or damaged cover.	SF		
*** {Severity H}			
*** Valve box full of debris/sediment.**			
Observation:			
a. Debris/sediment within 2' of valve.	CF		
*** {Severity M}			
b. Valvebox full of debris/sediment.	CF		
*** {Severity H}			
c. Surcharged valvebox.	EA		
*** {Severity H}			

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. U.S. Corps of Engineers EP 415-1-261, Vol. 4, Quality Assurance Representative's Guide
6. USACERL TR M-91/01, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems
7. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 23.09.02-1
2	GS-II 23.09.03-2
3	GS-II 23.09.05-3

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 23.09.02-1
2	GS-III 23.09.03-2
3	GS-III 23.09.03-3
4*	GS-III 23.09.03-4*
5	GS-III 23.09.04-5
6	GS-III 23.09.05-6
7	GS-III 23.09.05-7
8	GS-III 23.09.05-8
9*	GS-III 23.09.05-9*
10*	GS-III 23.09.05-10*
11*	GS-III 23.09.06-11*
12*	GS-III 23.09.06-12*
13*	GS-III 23.09.06-13*
14	GS-III 23.09.06-14
15	GS-III 23.09.06-15

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 23.09.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988

2. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 23.09.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-II 23.09.05-3

Application

This guide applies to the investigation of deterioration of wood support poles of piping, fittings and valves due to insect infestation, rot or fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.09.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 23.09.02-1

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify, appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 23.09.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.09.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating. Tag and lock out disconnect.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 23.09.04-5

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-6

Application

This guide applies to the investigation of deterioration of wood support poles of above ground piping, fittings and valves due to insect infestation, rot and fungi damage.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Sound with hammer.
2. Bore or core (should be angled to prevent water accumulation). Plug hole with treated dowels. Examine core at the site and send to laboratory for biological studies.
3. Test with a moisture meter.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. One-pound hammer
2. Increment borer
3. Moisture meter
4. Treated wood dowels

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

3. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-7

Application

This guide applies to the investigation of cracks in concert support poles of above ground piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and height.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-8

Application

This guide applies to the investigation of cracks and cracked welds in metal support poles of above ground piping, fittings and valves.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.
4. Perform NDT, in this case high frequency ultrasonic inspection of the cracks to determine extent of subsurface damage.
5. Check any other suspect areas such as patches and repairs.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire brush
2. Dye penetrant and developer
3. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-9*

Application

This guide applies to the use of ultrasonic testing equipment to investigate the interior of piping for leaks, cracks and separations. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of the Potable Water Distribution System.

1. Notify affected personnel and obtain permission to take piping out of service.
2. Acquire confined space entry permit from base safety officer.
3. Always have one person standing buy outside when someone is working inside a confined space.

Inspection Actions

1. Isolate the pipe section.
2. Perform the ultrasonic test on pipe section.
3. Document the readings and compare to wall thickness of piping in ASTM manual to determine of piping is defective or damaged.
4. Return pipe to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic testing equipment
2. Test vehicle (Smart Pig)

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9* (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-9*

References

1. NAVFAC MO-322, Vol 2, Inspection of Shore Facilities, 1993

2. Nondestructive Testing of Water Mains for Physical Integrity. American Water Works Association. ISBN 0-89867-620-7. 1992

3. Water Audits and Leak Detection, Manual of Water Supply Practices, American Water Works Association, AWWA M36, 1990

4. Tri-State Utilities, Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 10*

COMPONENT: PIPING, FITTINGS AND VALVES - ABOVE GROUND
CONTROL NUMBER: GS-III 23.09.05-10*

Application

This guide applies to performing an efficiency check of the flow rate of the heating hot water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-11*

Application

This guide applies to the investigation of leaks in underground heating water distribution lines, triggered by customer complaint or suspected by extraordinary conditions observed in the normal course of operations.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. In the suspect area, use an electronic pipe locator to determine the exact location of the pipe. Mark the location of the ground or pavement over the line with spray paint.
2. Along the line, visually check for signs of leakage of direct buried pipe (excessive, greener grass, erosion or soil or cave-ins).
3. Ensure system pressure is greater than 15 PSI.
4. Using a ground microphone (thumb tack), listen for leak sounds along the line every 5-10 FT. Write notes on sound intensities or take meter readings if so equipped.
5. The strongest signal usually indicates the location of the leak. Verify the location with a second listening taken at night (water usage normally minimal).
6. Double check your findings with ground microphone and probe attachment.
7. Report leak location for excavation and repair.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Electronic pipe indicator
2. Ground microphone (thumb tack) (probe)
3. Can of spray paint

Recommended Inspection Frequency

Perform this survey annually at the direction of the facility manager based on local factors and problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 11* (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-11*

References

1. AWWA Water Audits and Leak Detection, First Edition, 1990

2. AWWA Destructive Testing of Water Mains for Physical Integrity, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-12*

Application

This guide applies to the use of compressed air to test the casing integrity of the pressure testable conduit system. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This procedure is not applicable for tile conduit systems, corrugated conduit systems or any concrete trench systems.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to perform the test.
2. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Check to be sure conduit end plates properly seal the conduit.
2. Pressurize the air space in the conduit to 15 PSI using the drain plug or vent pipe opening in the end plate as a connection for the air compressor hose.
3. Cut off compressor.
4. Record readings of the air pressure inside the conduit every ten minutes for a minimum of one hour.
5. Reinstall the drain plug and or vent pipe in the end plate as necessary.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Portable air compressor and hose
2. Pressure gauge

Recommended Inspection Frequency

Follow manufacturers recommendations for frequency of inspection of the conduit system. If there is no manufacturer's recommendation an inspection should be performed on a three year cycle or whenever the desired degree of reliability justifies the procedure.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 12* (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-12*

References

1. USACERL TR M-91/01, March 1991, Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 13*

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-13*

Application

This guide applies to performing an efficiency check of the flow rate of the heating water system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications of the system main pumping station to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 14

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-14

Application

This guide applies to the investigation of the integrity of the insulation on the underground piping system.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and system Safety Section.

1. Always have one person standing by outside when someone is working inside a manhole.

Inspection Actions

1. Observe area above and along route of underground piping to determine if high heat loss is evident by such observations as burnt grass or in winter by rapid snow/ice melting.
2. Remove drain plug from end of conduit end plates in the manholes and drain conduit to determine if amount of water accumulated in the air space between the insulated heat carrying pipe and the conduit could have effected the integrity of the pipe insulation.
3. Reinstall drain plug.
4. Remove a sampling of removable protective jacket on the pipe insulation in the manholes to determine condition of the insulation.
5. Reinstall protective jacket on the pipe insulation.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. USECERL, TR M-91/01, March 1991 Guidance for Manhole Rehabilitation in Army Underground Heat Distribution Systems

2. NAVFAC DM-3.8, Exterior Distribution of Utility Steam, High Temperature Water, Chilled Water, Fuel Gas and Compressed Air, July 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-15

Application

This guide applies to performing a performance check of the impressed current cathodic protection system.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Review the design specifications and inspection records of the system.
2. Check for the proper performance of the CP system per the requirements of NACE RPO169-92 and RPO286, latest edition.
3. Document the results, compare to the design specifications and report results to the facility manager.

Special Tools and Equipment

No special tools are required.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 15 (Continued)

COMPONENT: PIPING, FITTINGS AND VALVES - UNDERGROUND
CONTROL NUMBER: GS-III 23.09.06-15

References

1. NAVDOCKS MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992.

2. Code of Federal Regulations, Title 40;
   Part 280,
   Part 192,
   Part 195,

3. U.S. Army Regulations, AR 200-1.

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92, (Metallic Buried Pipe).
   RPO285, latest edition, (Metallic Buried Tanks).
   RPO286, latest edition, (Pipelines)
   RPO388, latest edition, (Steel Waste Water Storage Tanks).

5. Material Performance Magazine, September 1992, Computer monitoring of Cathodic Protection Systems for Underground Structures.

APPENDIX A

ABBREVIATIONS

AC	Alternating Current
AIC	American Institute of Chemists
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
CMU	Concrete Masonry Unit
DCD	Data Collection Device
DIA	Diameter
EA	Each
FT	Foot
GPM	Gallons Per Minute
GS	Guide Sheet
HP	Horse Power
HRS	Hours
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive Testing
PE	Professional Engineer
PM	Preventive Maintenance
PSIG	Pounds per Square Inch Gauge

APPENDIX A

PVC	Polyvinyl Chloride
RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measurement
YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
−	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Abrasions	A scraping or rubbing off, as of skin. A wearing away by rubbing or scraping, as of rock by wind and water.
Accessible	That which can be approached or entered; easy to approach or enter.
Aggregate	An inert granular material such as natural sand and gravel which when bound together into a mass by a matrix forms concrete or mortar.
Alignment	An aligning or arrangement in a straight line; a ground plan , as of a field work , railroad etc.
Ammeter	An instrument for measuring the strength of an electric current (rate of flow) in terms of amperes.
Arcing	The band of sparks or incandescent light formed when an electric discharge is conducted from one electrode or conducting surface to another, characterized by relatively high current and low potential difference between electrodes.
Arroyo	A small steep sided watercourse that may have nearly a flat floor, usually dry except after heavy rains.
Blistering	To cause blisters (an enclosed pocket of air mixed with water or solvent vapor); or a raised area on the surface of a metallic or plastic object caused by the pressure of gases developed while the surface was in a partly molten state, or by diffusion of high-pressure gases from an inner surface.
Catch Basins	A reservoir, especially for catching and retaining surface drainage over a large area, in which sediment may settle.
Centrifugal	Moving or tending to move away from a center (conveying away from a center).
Commutator	That part of a direct-current motor or generator which serves the dual function, in combination with brushes, of providing an electrical connection between the rotating armature winding and the stationary terminals, and of permitting reversal of the current in the armature windings.
Compressor	A machine for compressing air or other gases.

APPENDIX B

Contraction	The action or process of becoming smaller or pressed together, as a gas on cooling. Of concrete, the sum of volume changes occurring as the result of all processes affecting the bulk volume of a mass of concrete.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Coupling	A metal collar with internal threads used to connect two sections of threaded pipe. The mechanical fastening that connects shafts together for power transmission.
Crimped	Bent or warped, to offset a structural steel member so that it will fit over the flange of another member.
Culvert	A passage under a road, railway embankment, or canal which allows for the flow of water. Construction may be open or closed; may be of timber, arched masonry, or metal or concrete pipe.
Diaphragm	A separating wall or membrane, especially one which transmits some substances and forces but not others. In general, any opening, sometimes adjustable in size, which is used to control the flow of a substance or radiation.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Dry Barrel Valve	A fire hydrant which is controlled by a valve located below the frost line at the intersection with the main. The valve is usually a compression or knuckle-joint type which may open with the pressure or against pressure. Any water that may remain in a closed dry-barrel hydrant will drain through a small valve at the bottom. This drain valve opens as the main valve approaches the closed position.
Elevation	The vertical distance above or below some established reference level. A drawing showing the vertical elements of a building, either exterior or interior.
Embankment	A raised structure of earth, rocks, or gravel, usually intended to retain water or carry a roadway.
End Bells	A hollow metal cylinder closed at one end and flared at the other. A conical device that seals the top of a blast furnace.

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Evacuation	An emptying out, a removal of contents; a removal of air so as to produce a vacuum.
Expansion	The increase in length or volume of a material, or a body, caused by temperature, moisture, or other environmental condition.
Filter	A device to separate solids, such as dust from air. A device to separate solids from liquids. A layer or combination of layers of pervious materials designed and installed in such a manner as to provide soil drainage, yet prevent the movement of soil particles due to flowing water.
Fitting	A pipe part, usually standardized, such as a bend, coupling, cross, elbow, reducer, tee, union, etc.; used for joining two or more sections of pipe together. The term usually is used in the plural. An accessory such as a bushing, coupling, locknut, or other part of an electric wiring system which is intended to perform a mechanical rather than an electrical function.
Flange	A projecting collar, edge, rib, rim, or ring on a pipe, shaft or the like. Also one of the principle longitudinal components of a beam or girder which resists tension or compression.
Float	Anything which stays or causes to something else to stay, on the surface of a liquid or suspended near the surface. A floating ball or device that regulates the valve controlling water level.
Float Valve	A valve which controls the flow of water; its opening or closing depends on the position of a float which rides on the surface of the water in a tank, as in a water closet.
Foundation	Any part of a structure that serves to transmit the load to the earth or rock, usually below ground level; the entire masonry substructure.
Frost Line	An imaginary line indicating the depth of frost penetration in the ground.
Gaskets	A continuous strip of resilient material attached to a panel or frame to provide a tight seal between the frame and the panel. Any ring of resilient material used as a joint to prevent leakage.
Headwall	A masonry or concrete retaining wall at the outlet of a drain.

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Hydrant	An apparatus for drawing water directly from a main; consists of a hollow metal cylinder provided with one or more nozzles to which a hose may be attached, or with a valve or faucet, used for supplying large amounts of water.
Hydraulic	Operated or effected by the action of water or other fluid of low viscosity.
Hydrostatic Pressure	The pressure equivalent to that exerted on a surface by a column of water of a given height.
Impellers	The rotating member of a fan, turbine, blower, axial or centrifugal pump, or mixing apparatus. Also known as a rotor.
Infiltration	To pass or cause (a fluid) to pass, through small gaps or openings; filter; penetration. The seepage or flow of air into a room or space through cracks around windows, under doors, etc.
In-situ	In position; in its original place.
Insulation	A material providing high resistance to heat flow; usually made of mineral wool, cork, asbestos, foam glass, foamed plastic, diatomaceous earth, etc. fabricated in the form of batts, blankets, blocks, boards, granular fill and loose fill.
Isolators	A passive attenuator in which the loss in one direction is much greater than in the opposite direction; a ferrite isolator for waveguides is an example. Any device that absorbs vibration or noise, or prevents its transmission.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Media	Material of controlled pore size used to remove foreign particles or liquid droplets from fluid carriers.
Packing Glands	Packing is the stuffing or elastic material around a shaft or valve stem or around a joint to prevent leakage. A stuffing box surrounds a shaft to prevent leakage by the use of packing; commonly used on water pumps; the packing gland is a movable part that compresses the packing in the stuffing box.

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Pedestal	A support for a column, statue, or piece of machinery. An upright compression member the height of which does not exceed three times its least lateral dimension.
Plumb	Exactly vertical.
Pneumatic	Pertaining to or operated by air or other gas.
Pop-outs	A conical fragment that has broken out of the surface of the concrete leaving small holes. Generally a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone. Pop-outs are caused by reactive aggregates and high alkali cement. They are also caused by aggregates such as shale, which expand with moisture.
Potable	Fit to drink; something drinkable.
Reciprocating	Moving alternately back and forth; interchange position.
Reservoir	A place where anything is collected and stored, generally in large quantity; especially a lake or pond in which water is stored for use. A receptacle or part in an apparatus for holding a fluid, as oil, ink, etc..
Run-out	This term generally applies to the horizontal of branch circuits or the measurement of play in a bearing or shaft.
Scaling	The gradual and continuing loss of surface mortar and aggregate over an area; due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles.
Seals	A tight closure as against the passing of air and water, something that closes or fastens tightly or securely.
Seepage	The slow movement of water through a soil. The quantity of water which has slowly moved through a porous material, such as soil.
Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.

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Swale	A long, narrow, generally shallow, sometimes swampy, trough like depression in the midst of generally level land. A tract of low, usually wet land. A depression in a stretch of otherwise flat land.
Terminal	An electrically conductive element, attached to the end of a conductor or piece of equipment for connection to an external conductor. The ornamental finish, decorative element, or termination of an object, item of construction, or structural part.
Thrust Block	Used to stabilize and control the expansion and contraction of long runs of pipe through the longitudinal axis by the placement of a concrete mass at the point where the line makes a bend (usually when it enters the ground for an underground run) the concrete acts as a reaction wall at the rear of the push pit. The weight of the concrete acts to anchor the line so that expansion or contraction is absorbed by the expansion loop.
Transverse	Refers to anything which is applied to the plane of the longitudinal axis of a structure, such as a wind load.
Vibration	Rapid, periodic, to-and-fro motion or oscillation of an elastic body or the particles of a fluid when displaced from the rest position or position of equilibrium, as in transmitting sound.
Vitrified	Having been changed into glass or a glass-like substance by fusion, due to heat.
Voltmeter	An instrument for measuring the voltage drop between any two points in an electric circuit.

APPENDIX C

LIFE CYCLES

23 INFRASTRUCTURE

23.01 POTABLE WATER DISTRIBUTION SYSTEMS

Pumps		15 Years
Motors		15 Years
Controls		15 Years
Piping And Fittings		30 Years
Valves		15 Years
Hydrants		35 Years
Meters		15 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Sources:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

23.02 NON-POTABLE WATER DISTRIBUTION SYSTEMS

Pumps		15 Years
Motors		15 Years
Controls		15 Years
Piping and fittings		30 Years
Valves		30 Years
Anchors and supports		10 Years
Filters		5 Years
Hydrants		35 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

APPENDIX C

23.03 STORM WATER COLLECTION SYSTEMS

Culverts - concrete	35 Years
Culverts - galvanized steel	20 Years
Piping	30 Years
Manholes and catch basins	30 Years
Pumps	15 Years
Motors	15 Years
Controls	15 Years
Arroyos	50 Years
Ditches	50 Years
Swales	50 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

23.04 SANITARY SEWER COLLECTION SYSTEMS

Pumps	15 Years
Motors	15 Years
Sewage Ejectors	15 Years
Air Compressors-Reciprocating	15 Years
Tanks	30 Years
Controls	15 Years
Piping And Fittings	30 Years
Manholes/Cleanouts	30 Years

Source:
Means Facilities Maintenance Standards, Roger W.Liska, PE, AIC, 1988

23.05 CHILLED WATER DISTRIBUTION SYSTEMS

Pumps		15 Years
Motors		15 Years
Controls		15 Years
Piping and Fittings		30 Years
Valves		15 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

APPENDIX C

23.07 STEAM DISTRIBUTION SYSTEMS

Piping and Fittings		30 Years
Valves		15 Years
Steam Traps		5 Years
Strainers		20 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

23.08 STEAM CONDENSATE RETURN SYSTEMS

Piping and Fittings		30 Years
Valves		15 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

23.09 HEATING HOT WATER DISTRIBUTION SYSTEMS

Pumps		15 Years
Motors		15 Years
Controls		15 Years
Expansion Tanks		20 Years
Piping and Fittings		30 Years
Valves		15 Years
Manholes		30 Years
Valve Boxes	Steel:	20 Years
	CMU:	30 Years
	Concrete:	40 Years

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC,1988